English
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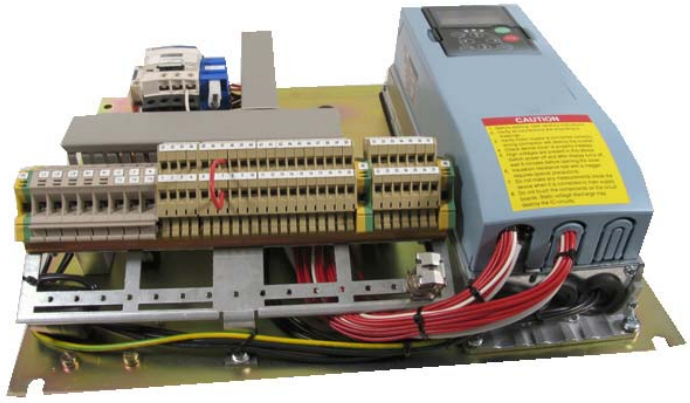

SERVICE MANUAL FOR FREQUENCY CONTROL SYSTEM

R&M
MATERIALS
HANDLING
INC.

R&M Materials Handling, Inc.
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Springfield, Ohio 45502
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Read the instructions supplied with the product before installation and commissioning.

Keep the instructions in a safe place for future reference.

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This manual rev 5.0 is for inverter rev 5.1 with software Ind2V081.

- **Before starting, read the instructions carefully.**
- **Verify all of the connections are in accordance to the drawings.**
- **Verify the motor supply is connected correctly, faulty connection will destroy the inverter.**
- **Check the device cover is properly installed.**
- **High voltages are present in this device. Switch the power off and after the display turns off, wait 5 minutes before opening the cover.**
- **Insulation resistance test with a megger multimeter requires special precautions.**
- **Do not make any measurements inside the device when it is connected to the main supply.**
- **Do not touch the components on the circuit boards. Electrostatic discharge may cause damage or destroy the IC-circuits.**
- **Check all ventilation holes are clear and unobstructed.**
- **Check that hot air coming from the brake resistors does not cause any danger.**
- **Do not make any inspections unless the supply has been disconnected by the main switch.**
- **It is forbidden to use radiophones or portable phones near this device with the doors open.**
- **All the doors and covers must be closed during crane operation.**
- **Drive is not intended to be used in a low-voltage public network, which supplies domestic premises. Radio frequency interference is expected if used in such a network.**

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1 GENERAL

1.1 Technical data

Power class	002F	003F	004F	005F	007F	011F	015F	018F	022F	030F	037F	045F	055F
Power (kVA) at 400V	4.5	5.5	7	9	13	17	22	29	33	40	50	60	75
Output current In (A)	6.5	8	10	13	18	24	32	42	48	60	75	90	110
Max. current 1min (A)	10	12	15	20	27	36	48	63	72	90	113	135	165

Overloadability	1.5 x In , 1min/10min
Max. output voltage	Equal to supply voltage
Supply	
Supply voltage	380-500VAC
Allowable voltage fluctuation	+/- 10%
Nominal supply frequency	50/60Hz +/- 5%
Signal input levels	
Digital controls	S1, S2, DIA3, DIA4, DIA5, DID1, DID2, DID3, DID4, DID5: 42 … 240VAC; 15mA
Encoder feedback	EA+/- and EB+/-; 0/24V; 3kΩ; floating differential inputs
Control features	
Control method	Open loop vector control
Frequency control range	0 ... 250Hz
Frequency command	Motor potentiometer or 2-4-step controller
Limit switch functions	Slowdown and stop limit inputs for both directions
Speed control range	s_N ... 100% (s_N= motor nominal slip)
Speed accuracy	1% of nominal speed at speed range 10 ... 100% 1/3 of motor nominal slip at speed below 10%
Extended speed range	100 ... 200%
Braking torque	150%
Protections	
Stall prevention	During acceleration and constant speed
Motor overload protection	Thermistor based temperature measurement
Overload protection	Fault is detected if the current momentarily exceeds 280% of rated current
Undervoltage / blown fuse	Fault is detected if DC voltage drops below 333V
Overvoltage protection	Fault is detected if DC voltage exceeds 911V
Momentary power loss	Immediate fault stop
Inverter overtemperature	Temperature sensor on the heat sink
Mechanical brake	Circuit breaker
Braking transistor	Electronic supervision for the braking chopper and for the braking resistor
Ground fault	Provided by electronic circuitry
Overspeed / stall,	
Speed difference supervision	Independent measurement using sensor bearing, pulse wheel or encoder
Ambient conditions	
Ambient temperature	-10°C ... +55°C (14°F ... 131°F) for ED≤60%
Storage temperature	-40°C ... +60°C (-31°F ... 140°F) dry
Humidity	<95%RH (no condensation)
Altitude	Maximum 1000m at In. Above 1000m: In reduces 1% per each 100m. Above 3000m: consult factory.
Vibration	Operation: maximum displacement amplitude 3mm at 2-9Hz. Maximum acceleration amplitude 0.5g (5m/s²) at 9-200Hz
	Conforms to LV and EMC directives.

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1.2 Basic description

Inverter has many advantages and offers many new features, when compared to other inverter based systems, which might be used in crane applications.

Inverter	The specific crane features for the inverter hardware and the special software are achieved by combining the experience and know-how of crane applications with the latest technology.
Crane user interface	Interface with pre-designed locations for typical crane functions. The main part of this interface is carried out by a terminal strip, which has separated sections for signals with main, control and electronics voltage levels.
Brake control	Includes the brake contactor for disk brakes. Includes also DC-rectifier.
Electrical Braking	Includes a braking transistor and a braking resistor.
Control methods	Can be controlled by the electronic potentiometer control with 2-step or 3-step pushbuttons, the multistep control with 2-4-step controllers.
Limit switch functions	Built-in slowdown (S11, S21) and stop limit switch (S12, S22) functions for both running directions.
Speed supervision	Inverter includes a speed supervision unit SSU, which is separate from the inverter and not dependent on software. This safety circuitry is used to monitor the speed of the motor. In case of speed difference, overspeed or stall the speed supervision unit stops the motion immediately.
Protections	Includes a motor thermal protection, which is based on motor temperature measurement by Klixon placed in motor windings. A great number of other protections included are shown in the technical data.
Tested parameters	Inverter includes tested parameters with different motors for all power ratings. This is a benefit, which makes every inverter delivery a proven solution. The tested and pre-set motor parameters enable a quick start-up in crane commissioning.

1.3 Main components

The main components are:

		Power class
A1	Inverter	
F7	Brake supply circuit breaker	007 - 055
K7	Brake contactor	
G1	Brake control unit REC12	002-011
G1	Brake control unit ESD141	015-055
F71	Circuit breaker for the second brake contactor	055
K71	Second brake contactor	055

The most important external components are:

R1	Braking resistor unit
M1	Hoisting motor
Y1	Mechanical brake
A5	KAE234 Proximity switch buffer amplifier for speed sensor
B5	Speed sensor
B6	Thermal sensor for motor protection
	Overload protection device
	Control devices (switches, pushbuttons etc.)
	Limit switches

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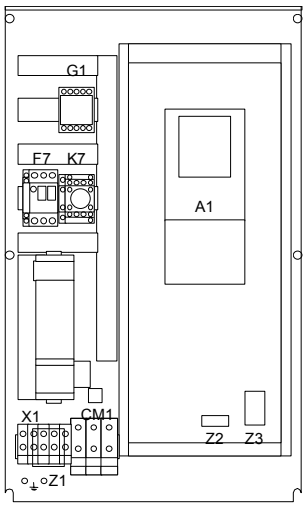
Example layout



1.4 Functional description

Operation when power is switched on

- Stop limit switches S12 & S22 and slow down limit switches S11 & S21 are assumed to be normally closed, as well as the emergency stop button ES.
- The control voltage is supplied to X1:37. The main voltage is connected to inverter power supply and inverter wakes up. If the control voltage is connected to RDY-signal and the fault circuit is OK, inverter is ready to operate in about 1-2 seconds.
- If either of the direction signals S1 or S2 is on, the display shows F6 and driving can begin only after the direction signals have been off for a while.

Normal operation

- For the description of the speed reference setting see chapter "Control methods".
- Hoisting (lowering) starts when switch S1 (S2) closes. Closing the contact ROB2 on A1 energizes K7, which opens the brake (in model 055 the brake can be controlled also by K71). Motor accelerates according to the acceleration ramp setting to the selected speed.
- When the switch S1 (S2) opens motor stops according to the deceleration ramp setting and the brake closes.
- R1 dissipates the regenerated energy during lowering periods. The power supply to R1 is controlled by A1. If the braking resistor fan(s) are included in external resistor unit, they start to operate when power is supplied to the braking resistors. The cooling continues about 4-5 minutes after electrical braking to ensure that the temperature of the resistors drops below 150°C (302°F).

Other features

- Slowdown limit switches S11 and S21 provide position dependent frequency limiting.
- Any reason which opens contact RDY, stops the operation of inverter.
- In case of overload, motor overheating etc. the hoisting can be disabled by cutting the direction signal in terminal X1:8.
- Thermistor relay function, which can be used when needed.
- When the stop limit switch S12 or S22 opens, K7 (K71 in model 055F) de-energizes and the mechanical brake stops the motion.
- Independent speed supervision unit, SSU
- The speed measurement and supervision can be done either with encoder, bearing sensor or proximity switch. The measured signals are square wave pulses. The frequency of the pulses is proportional to the speed of the motor and if the frequency is too high, overspeed is detected. If there are no pulses a stall situation is detected.

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If the actual speed differs too much from the supply frequency of the motor, the speed difference supervision stops the motion.

Proximity switch buffer amplifier A5 amplifies the sensor pulses and filters out disturbances. The amplifier is located close to the sensor.

1.5 Factory code example (Factory: D2L)

D2L	007	F	V	51	A	0	N
HS01	(ELE83)	(ELE83)	(ELE02)				ELE97
1-3	4-6	7	8	9,10	11	12	13

Pos.	Code	Feature code	Feature	Available properties			
1-3	**D2L**	HS01	Device name	D2L			
4-6	**007**	(ELE83)	Power rating class	002 - 055		ELE83 values are composed of two features, Power rating class and Supply voltage. e.g. 007F = ELE83 value	
7	**F**	(ELE83)	Supply voltage	F 380 – 500 VAC, 50/60 Hz			
8	**V**	(ELE02)	Control voltage		ELE02 value		ELE02 value
				Y 42VAC, 50/60 Hz		T 115VAC, 50/60 Hz	115
				P 48VAC, 50/60 Hz	48	V 230VAC, 50/60 Hz	230
9,10	**51**		Revision code	The latest revision may differ.			
11	**A**		Braking resistor type	A External resistor			
12	**0**		Mounting	0 Standard panel			
13	**N**	ELE97	EMC level	S Standard, without EMC filters (grounded network) N EMC, Second environment (grounded network)		0 IT network (non-grounded network)	

1.6 Description of the control modes

There are three different control methods (command modes) available:

1	EP2	Electronic motor potentiometer function. Stepless control using a 2-step controller.
2	EP3	Electronic motor potentiometer function. Stepless control using a 3-step controller.
3	MS	Multistep control (4 steps)

The control mode of inverter is selected by parameter P2.1.4. See chapter Control methods. The parameters assigns digital inputs S1, S2, OK, DIA3-DIA5 and DID1-DID5.It is not possible to chance the functions of the inputs separately. The state of inputs can be checked from parameters V4.7.12 and V4.7.13. The input assignment according to the selected mode is explained in the following table:

Control mode		**EP**	**EP3**	**MS**
Parameter P2.1.4		**1**	**2**	**3**
Signal	Terminal			
S1	X1:8	S1	S1	S1
S2	X1:9	S2	S2	S2
OK	X1:7	OK	OK	OK
DIA3	X1:10	AP	AP	MS2
DIA4	X1:11	Not used	HOLD	MS3
DIA5	X1:12	Not used	not used	MS4
DID1	X1:38	FWE	FWE	FWE
DID2	X1:39	S11	S11	S11
DID3	X1:40	S21	S21	S21
DID4	X1:41	S12	S12	S12
DID5	X1:42	S22	S22	S22

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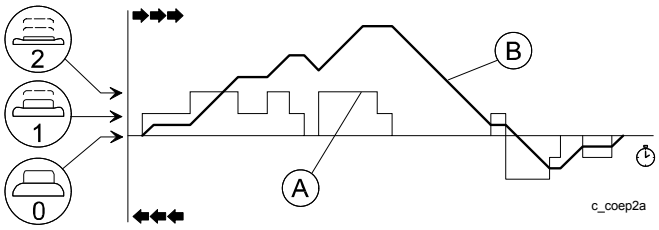
Desired speed levels for multi-step control mode are selected with following parameters:

Speed	Parameter	Input
Speed 1	P2.2.8. / P2.2.9.	S1/ S2
Speed 2	P2.1.7.	MS 2
Speed 3	P2.1.8.	MS 3
Speed 4	P2.1.9.	MS 4

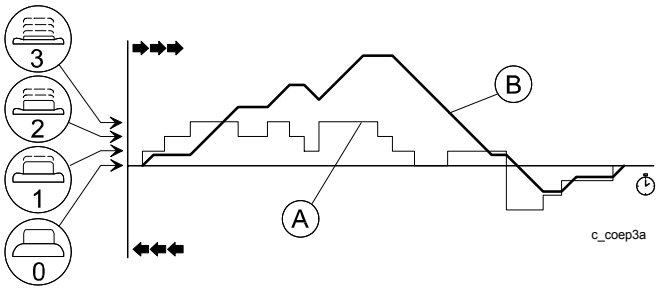
1.6.1 EP2-control



A. Pushbutton / controller position
B. Speed

0) "decelerate to zero"
1) while starting "drive minimum speed"
while running "hold speed"
2) while running "accelerate"
while running at maximum speed "hold speed"

1.6.2 EP3-control



A. Pushbutton / controller position
B. Speed

0) "decelerate to zero"
1) step 1 "drive minimum speed"
2) step 2 "hold speed"
3) step 3 while running "accelerate"
while running at maximum speed "hold speed"

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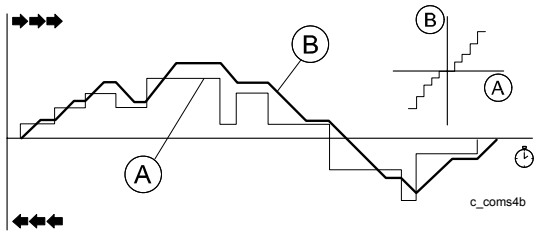
1.6.3 MS4-control



A. Controller position
B. Speed

0) "decelerate to zero"
1) step 1 "drive minimum speed"
2) step 2 "drive speed2"
3) step 3 "drive speed3"
4) step 4 "drive maximum speed"

1.7 Mechanical brake control

Inverter has a brake contactor to control electromechanical disk brake of hoisting motor. The disk brake is opened and kept open during run by DC-voltage. When there is no voltage present the brake is closed and also kept closed by spring force.

The brake is controlled so that during starting the motor first generates torque and after that the brake is opened. The same applies for stopping; while the brake is being closed, the motor still generates torque. During a direction change, the brake is kept open all the time. Inverter decelerates the motor to a stop according to the set deceleration time when the run command is switched off, so the brake is used only as a holding brake. This way brake wear is minimized. Only if a failure occurs or the emergency stop button is pushed, the brake closes immediately stopping the motor and the load.

Models 002F-011F have a built-in REC12 brake control unit, which is a line voltage half-wave rectifier. The half-wave type rectifier reduces losses and is enough to open the brake. There is a contactor to switch the line voltage on and off.

Models 015F-055F have a built-in ESD141 brake control unit, which is a line voltage full/half-wave rectifier. Full-wave rectification is used to open the brake quickly. Then, the rectifier changes to a half-wave type, which reduces losses, but is enough to keep the brake open. There is a contactor to switch the line voltage on and off. The same contactor also disconnects the DC-voltage directly from the brake coil, which guarantees that the brake closes fast.

Model 055F includes a 3-phase AC-supply for the brake control. Inverter controls this line and it is protected by an adjustable circuit breaker (max. 4.0A). When a shoe brake is used, brake closing is speeded up by capacitors. They are connected in parallel with the brake via the brake contactor NC-contacts. The connection is partially ready in inverter. Only the capacitors must be added outside inverter. This connection can also be used to control 2-phase disk brakes or a separate KA372B brake control unit.

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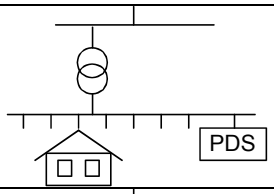
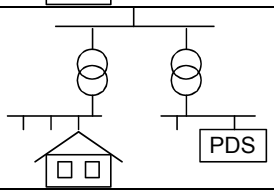
1.8 EMC

The abbreviated "EMC" stands for the Electromagnetic Compatibility. According to the European EMC directive "the apparatus shall be so constructed that:

- The electromagnetic disturbance it generates does not exceed a level allowing other apparatus to operate as intended
- The apparatus has an adequate level of intrinsic immunity of electromagnetic disturbance to enable it to operate as intended."

Declaration of conformity	With the declaration of conformity the manufacturer informs that device is manufactured to fulfill required EMC standards.	
CE-mark	The CE marking is a declaration by a manufacturer or importer located in the European Economic Area that a product complies with the safety and health requirements of the directive in question. The manufacturer demonstrates for the authorities that the product complies with the safety requirements within the EU.	
Environments	Immunity and emission requirements are divided in two levels in the product standard according to the environments.	
	First environment means environment that includes domestic premises and also establishments directly connected to a low-voltage power supply network.	
	Second environment means environment that includes all establishments other than those directly connected a low-voltage power supply network	
Fulfilled EMC-standards	• All products fulfil the immunity requirements defined in the EN 61800-3 Amendment 11 (2000) for the second environment. • N level products fulfil the emission requirements of the EN 61800-3 A11 2000 for the second environment.	

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2 INSTALLATION

2.1 Cubicles

Inverter is delivered with external braking resistor. Braking resistor types D2FR are installed in the same cubicle as the inverter itself. Braking resistor D2HR04F90R0S4 for 002 –005 is in own cubicle.

Power class	Standard cubicle	Cubicle size (mm)	Braking resistor (mm)
002 - 005	EEO25.604	400 x 600	400 x 400
007 – 015	CC600E	600 x 1000	Included
018 – 030	KA220D2	1000 x 1000	Included
037, 045	1½ x KA220D2	1½ x 1000 x 1000	Included
055	1½ x H15BD02	1½ x 1500 x 1000	Included

2.2 Braking resistor

Inverter is delivered with external braking resistor. Braking resistor types D2FR are equipped with cooling fans and thermistors. Circuit diagrams are in appendix.

Power class	Resistance (ohm)	Type
002 - 005	90	D2HR04F90R0S4
007	64	D2FR06F64R0S2
011, 015	45	D2FR12F45R2S2
018, 022	21	D2FR18F21R3S2
030	16	D2FR24F16R4S2
037, 045	11	2 x D2RF18F21R3S2
055	8	2 x D2FR24F16R4S2

In case of 2 resistor units, power supply to transformers has to be taken from the same phases.

2.3 Power cabling

2.3.1 Shielded motor cable

In crane application inverter fulfils EN61800-3/A11 (IEC 1800-3) second environment radiated emission requirements without shielded motor cable.

In the second environment, shielded motor cable is recommended to use in fixed installations, especially in buildings. However motor cables in crane and festoon power supplies are normally not shielded due to the practical reasons.

2.3.2 Double collectors

If the power is supplied to the crane via conductor rails, double collectors are needed. This ensures a reliable contact with the rail in all circumstances. Short interruptions and sparks between the conductor rail and the collector may cause nuisance tripping, other undesired operations and in worst case even permanent damage to components.

2.3.3 Cable selection

Cabling for inverter can be done using normal crane cables. All the cables must be dimensioned according to local regulations. Ambient temperature, cabling method (size of bunches etc.) and allowable current for the cable in use must be taken into consideration. If there are no other regulations, following values can be used (three phase 400V supply).

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The table below is based on ED ≤ 60% and ambient temperature +40°C (104°F). A higher ambient temperature may require increased cable sizes. The input current does not exceed the continuous current (Icont) of inverter, so it is selected to be the dimensioning current. If the actual load current is below inverter continuous current, then the fuses and the supply cable may be dimensioned according to the load current.

Power class			**002**	**003**	**004**	**005**	**007**	**011**	**015**	**018**	**022**
Continuous current	I_{CONT}	**A**	6.5	8	10	13	18	24	32	42	48
Fuse		**A**	10	10	10	16	20	25	35	50	50
Max motor cable length		**m**	50	50	50	50	50	50	50	50	50
		Ft	160	160	160	160	160	160	160	160	160
Motor cable	**40°C**	**mm^2**	1.5	2.5	2.5	2.5	4	6	10	10	10
	104°F	**AWG**	14	14	14	12	10	10	8	8	6
Braking resistor cable	**40°C**	**mm^2**	2.5	2.5	2.5	2.5	2.5	2.5	2.5	4	4
	104°F	**AWG**	14	14	14	14	14	14	14	12	12

Power class			**030**	**037**	**045**	**055**
Continuous current	I_{CONT}	**A**	60	75	90	110
Fuse		**A**	63	80	100	125
Max motor cable length		**m**	50	50	75	75
		Ft	160	160	240	240
Motor cable	**40°C**	**mm^2**	16	25	35	35
	104°F	**AWG**	6	4	2	2
Braking resistor cable	**40°C**	**mm^2**	10	10	16	16
	104°F	**AWG**	8	8	6	6

2.3.4 Cable protection

To protect the supply cables against short circuit there must be fuses or motor circuit breakers (MCCBs) installed at the mains end of the supply cable. Dimensioning of the fuses or MCCBs depends on the cable used and on the type of primary fuses or MCCBs. If there are no other regulations, the values given in this section can be used to dimension fuses (three phase 400V supply).

The overload protection of inverter protects both the supply and the motor cables. The fuses of the supply provide the short circuit protection.

2.3.5 Cable length

The maximum motor cable lengths in the preceding table are based on 150% of inverter rated current (=current during acceleration) and a 2.5 % voltage drop in the cable. For longer cables, the required conductor cross sectional area A (mm2) is given by formula

$$A = 2.43 \times \frac{l \times 1.5 \times I_F}{p \times U}$$

where l is the cable length (m)
I_F is the motor current (A) at shaft power P_F
p is the allowed voltage drop in %
U is the nominal motor voltage

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2.3.6 Du/dt filters

If inverter is not mounted on the crane, there has to be du/dt filter at motor supply. Also if total motor cable length (sum of motor cables) is over 100m with 002 –005 or over 200m with 007 –055, there has to be du/dt filter at motor supply.

Power class	Platthaus du/dt filter	Length (mm)	Width (mm)	Height (mm)	Weight (kg)	ID
002 – 003	ULC-910-920	100	110	180	1.2	52306553
004 – 005	ULC-914-931	125	110	200	3	52306554
007 – 018	ULC-918-951	155	125	225	7	52306555
022 – 045	ULC-923-927	190	135	260	12	52306556
055	ULC-942-1044	240	175	310	22	52306557

Du/dt filter should be as near inverter as possible

Note! All control cables must be placed as far from the motor and braking resistor cables as possible.

2.4 Signal cabling

2.4.1 Shielded signal cable

It's recommended to use twisted pair and braided shielded signal cables. Foil type shield is not sufficient enough in crane applications because of poor mechanical durability. Cable insulation material effects to cable capacitance. Recommended cable capacitance between signal-signal and signal-ground is equal or less than 100pF/m (31pF/ft).

It is not recommended to use shielded flat cable, because its capacitance is extremely high and this may cause high frequency interference.

2.4.2 Reference signals

Shielded round cables must be used for analog reference signals. The shield is to be grounded only at one end of the cable.

2.4.3 Sensor bearing

The cable for the sensor bearings must be shielded round cable and grounded 360° at both ends.

2.4.4 Encoder

The encoder connections may be split into two cables, then the signal conductors (4pcs) should go together in one cable and the supply and common (+24V/0V) together in another cable. The encoder cable(s) must be shielded round cable(s) and grounded 360° at both ends.

Note! All shielded cables must be placed as far from the motor cables as possible (>20cm). Shielding must be continuous. The "pigtail" (= the end to be connected) of the shield should not be used, instead 360° grounding should be used to minimize disturbances.

If control cable length is over 100m (from transformer to inverter) or inverter is not mounted on the crane, make sure that Basic I/O board (Slot A) is at least revision 271G and I/O Extension board (Slot D) is at least revision 266H

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2.5 EMC compatible grounding

2.5.1 Construction connections

All metal construction parts of the cubicle must be electrically connected to each other using largest possible surface area. Paint to paint connection must not be used.

2.5.2 Cable connections

Control cables and power cables should be separated and routed separately for eliminating noise coupling. The distance between braking resistor cables and the other cables should be kept as long as possible. The distance between the resistor cables should be kept as low as possible to prevent the antenna behavior. Cable lengths should be kept as short as possible to minimize coupling capacitances and inductances.

2.5.3 Shielded control cables

Shielded control cables should be grounded in both ends. The shield must be connected to the ground using the largest possible surface area. Extra intermediary terminators cutting the shield are not allowed, the shield should be as integrity as possible. Spare conductors should be grounded in the both ends. All shielded cable shields should be 360° grounded.

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3 COMPONENTS

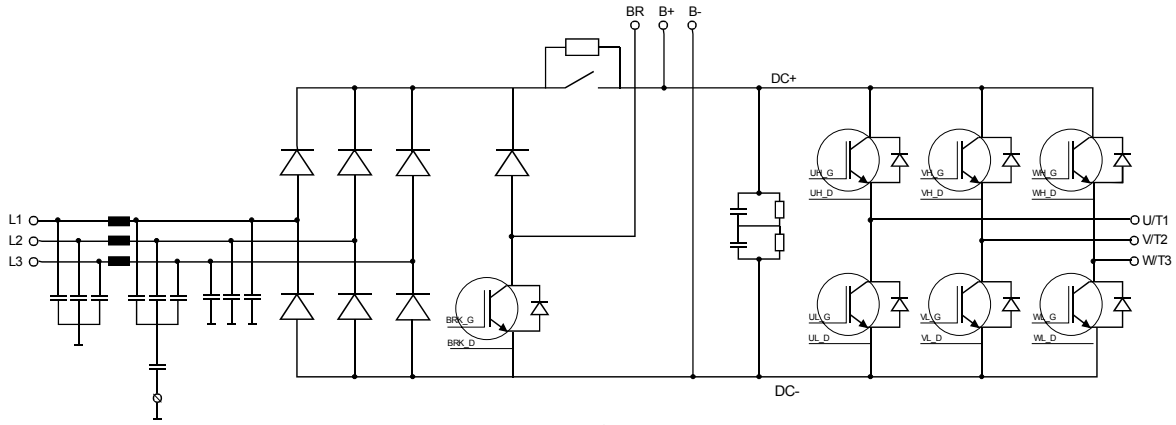
3.1 Inverter

Inverter (D2V) includes Power supply unit (PSU) and Control unit (CSU), which are separate parts. PSU includes supply, brake resistor and motor connections. IGBTs are placed to PSU. Microprocessors and ASIC are placed to CSU. Same CSU can be used in every power class.

D2V	In	1min Imax	Weight kg	Weight lbs
D2V002NF1e000	6,5	10	6	13
D2V003NF1e000	8	12	6	13
D2V004NF1e000	10	15	6	13
D2V005NF1e000	13	20	6	13
D2V007NF1e000	18	27	10	22
D2V011NF1e000	24	36	10	22
D2V015NF1e000	32	48	20	44
D2V018NF1e000	42	63	20	44
D2V022NF1e000	48	72	20	44
D2V030NF1e000	60	90	37	82
D2V037NF1e000	75	113	37	82
D2V045NF1e000	90	135	37	82
D2V055NF1e000	110	165	61	135

e defines emission level (0 = EMC level 0, N = EMC level N/S)

The main circuit diagram of D2V002 – D2V005



The main circuit diagram of D2V007 – D2V055

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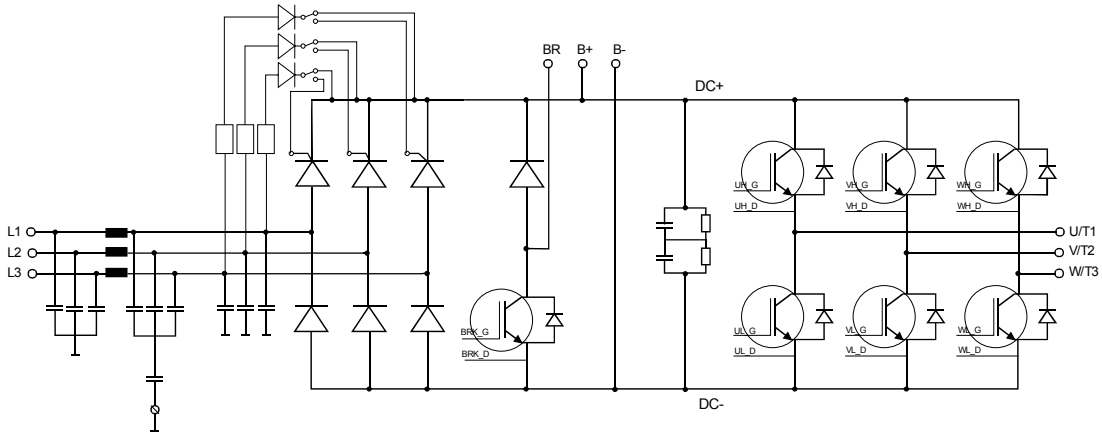

3.1.1 Power supply unit (PSU)

Power supply unit (PSU) includes the main circuit components. PSU has connectors for supply cables, motor cables and braking resistor cables. PSU also includes a D-connector for CSU-connection.

Main supply voltage terminals	
L1	Mains L1
L2	Mains L2
L3	Mains L3
PE	Protective earth
DC-bus terminals	
B-	DC-bus negative
B+	DC-bus positive / Brake resistor positive
R-	Brake resistor negative
Motor output voltage terminals	
U/T1	Motor U
V/T2	Motor V
W/T3	Motor W

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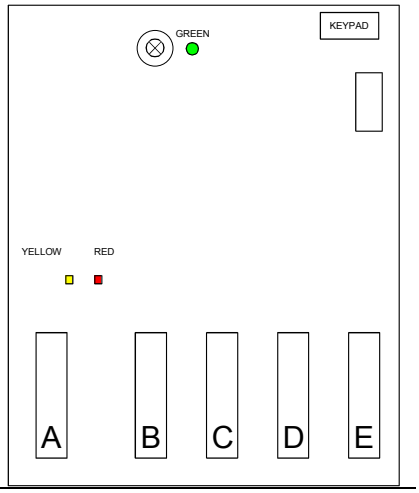
3.1.2 Control unit (CSU)

Control unit (CSU) includes a control board with five board slots for option boards and a control keypad for parameter adjustments. CSU is connected to PSU through a D-connector.

Yellow	Red	Status
blinking 0.5Hz	blinking 0.5Hz	Everything is OK. IEC Application Scheduler is running and Application is running
blinking 0.25Hz	blinking 0.5Hz	IEC Application Scheduler is running and Application is NOT running
OFF	blinking 0.5Hz	IEC Application Scheduler and Application are NOT running

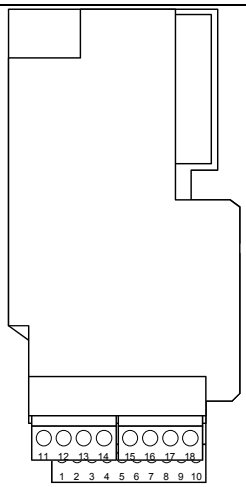
Green	Status
ON	PSU ready
OFF	PSU not ready



3.1.3 Basic I/O board (Slot A)

Basic I/O-Board is in CSU slot A. It has two board levels, one for electronics level signals (terminals 1-10) and one for control voltage signals (42-240Vac).

NXOPTA6 / Basic I/O board		ID: 52288046
Terminal	**Signal name**	**Description**
1	PUR	Not used
2	+15 V	Not used
3	AIN1+	Analog input 1 (0-10V)
4	AIN2+	Not used
5	AIN-	Common for analog input and output signals
6	AOUT1	Not used
7	AOUT2	Analog output 2 (0-10V)
8	DOA1	Not used
9	0V	I/O ground terminal
10	+24V	Not used
11	S1	Digital input 42-240Vac 50/60Hz (Direction S1)
12	S2	Digital input 42-240Vac 50/60Hz (Direction S2)
13	DIA3	Digital input 42-240Vac 50/60Hz
14	DIA4	Digital input 42-240Vac 50/60Hz
15	DIA5	Digital input 42-240Vac 50/60Hz
16	OK	Digital input 42-240Vac 50/60Hz (OK-signal). OK-input is connected straight to the ASIC. Inverter is ready to operate when OK-signal is active “1”.
17	COM	Common for 42-240Vac 50/60Hz
18	COM	Common for 42-240Vac 50/60Hz



The threshold voltage for digital inputs S1, S2, DIA3, DIA4, DIA5 and OK is 35VAC.

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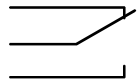
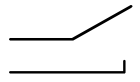
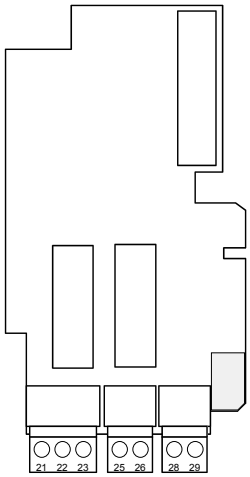
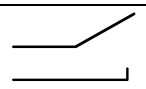
3.1.4 Relay / Thermistor board (Slot B)

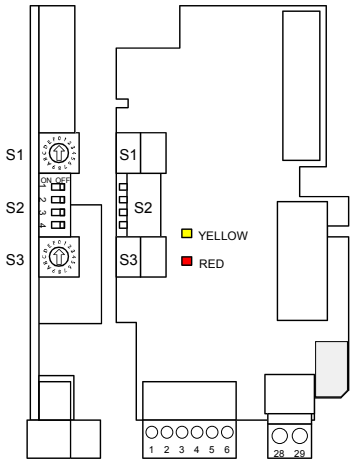
NXOPTA3 / Relay / Thermistor board			ID: 52305690
Terminal	**Signal name**		**Description**
21	ROB1		Relay output, 250V 8A
22	ROB1		
23	ROB1		
25	ROB2		Relay output, 250V 8A, normal open
26	ROB2		
28	T1		Thermistor input, double isolated, R_{trip}=4.7kΩ
29	T2		



3.1.5 SSU Speed Supervision board (Slot C)

SSU is in CSU slot C, see chapter Speed supervision settings.

SSU / Speed supervision unit			ID: 52288044
Terminal	**Signal name**		**Description**
1	EA+		Threshold voltage 10VDC
2	EA-		Threshold voltage 10VDC
3	EB+		Threshold voltage 10VDC
4	EB-		Threshold voltage 10VDC
5	+24V		+24VDC short circuit protected
6	0V		Common for encoder supply
28	ROC1		Relay output, 250V 8A, normal open
29	ROC1		



Relay contact ROC1 closes when inverter is powered and no faults occurs
Relay contact ROC1 opens if the SSU has tripped in:
Overspeed
Speed difference
Zero speed
Relay test fault
Watch dog fault

LED	Blinking	Status
Red	1Hz	OK
Yellow	0.25Hz	OK
Yellow	4Hz	Board internal fault or communication fault with control unit

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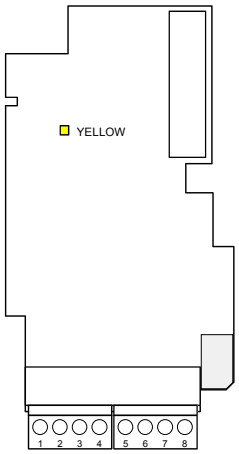
3.1.6 I/O Extension board (Slot D)

NXOPTB9 / I/O Extension board		ID: 52305691
Terminal	**Signal name**	**Description**
1	DID1	Not used
2	DID2	42-240Vac 50/60Hz
3	DID3	42-240Vac 50/60Hz
4	DID4	42-240Vac 50/60Hz
5	DID5	42-240Vac 50/60Hz
6	COM	Common for DID1-DID5
7	ROD1	Relay output, 250V 8A, normal open For fan of braking resistor unit
8	ROD1	



The threshold voltage for digital inputs DID1-DID5 is 35VAC.

LED	Blinking	Status
Yellow	0.25Hz	OK
Yellow	4Hz	Board internal fault or communication fault with control unit

3.2 Control voltage transformer

Power of control voltage transformer has to be n * 50VA + 50VA (min. 250VA), n = number of inverters. This power does not have to be added to otherwise needed transformer power.

3.3 Speed sensors

3.3.1 Sensor bearing

Inverter needs information about the motor rotation speed for stall, speed difference and overspeed supervision. Order codes of the bearing sensors are shown in the table below.

Motor type	Motor code	Pulses per revolution	Order code	Supply voltage	Max load
MF10MA200	T1	32	NM768NR3	24V DC	20 mA
MF10MB200	T2	32	NM768NR3	24V DC	20 mA
MF10MC200	T3	32	NM768NR3	24V DC	20 mA
MF11MA200	T4	64	NM768NR4	24V DC	20 mA
MF11MB200	T5	64	NM768NR4	24V DC	20 mA
MF13Z-200	T6	80	NM768NR5	24V DC	20 mA
MF13ZA200	T7	80	NM768NR5	24V DC	20 mA
MF13ZB200	T8	80	NM768NR5	24V DC	20 mA
MF13ZC200	T9	80	NM768NR5	24V DC	20 mA
MF13X-200	TA	80	NM768NR5	24V DC	20 mA

Sensor bearing requires KAE234 buffer amplifier. If channel A+ is damaged, channel B+ can be used instead in emergency situations.

Signal name	Sensor bearing wire colour	Wire colour between KAE234 and motor plug	Terminal number
+24V	Red	Brown	KAE234:6
0V	Black	Green	KAE234:2
A+	White	White	KAE234:1
B+	Blue	not connected	not connected

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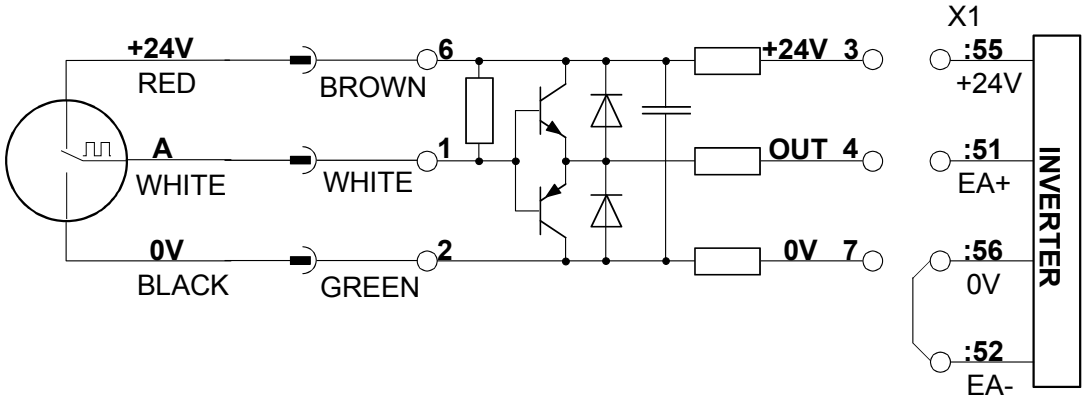

Critical damage if: The supply voltage is over 28V or a short circuit between the signal and the supply, or induction heating or hammer mounting. In case of sensor damage, the whole motor has to be changed.

Buffer amplifier must be located as close to the sensor bearing as possible (maximum distance 2.5m)

The cable between the buffer amplifier and inverter must be
- as far as possible from the cables of motor and braking resistor (minimum distance >20cm)
- a shielded and twisted cable
- grounded (the shield) at both ends, 360° grounding on inverter terminal
- the shield should be grounded always when going through terminals

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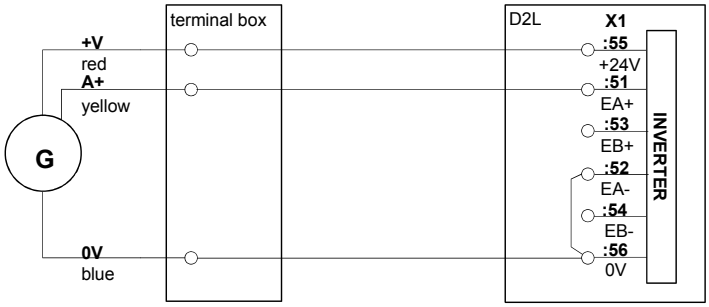
3.3.2 Encoder

Standard encoder has 24 pulses per revolution. It is also allowed to use 600, 1000, 1024, 2000 or 2048 ppr encoders, but then there has to be both channels connected.
Order code for 24 ppr encoder is NM701NR28.

Encoder connection examples are shown below. All signal wires shall be included inside a single shielded cable. Power supply to the encoder may also be included in the same cable.

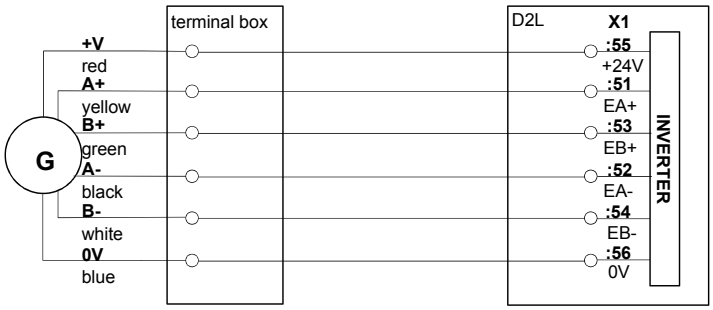
Standard connection

Encoder 24 ppr.



Standard connection

Encoder 600 ppr. or more



In standard encoders, there are also "zero outputs (Z+, Z-)", which should be left disconnected. If the encoder does not have negative channels (A- and B-), EA- and EB- must be connected to 0V at motor terminal box (alternative connection).

In order to avoid fault situations, the cable between the encoder and inverter must be
- as far as possible from the cables of motor and braking resistor (minimum distance >20cm)
- a shielded and twisted cable
- grounded (the shield) at both ends, 360° grounding on inverter terminal
- the shield should be grounded always when going through terminals

Some problems may occur when using shielded flat cable or in situations where the encoder cable has been placed too close (< 5cm) to the motor cables and braking resistor cables.

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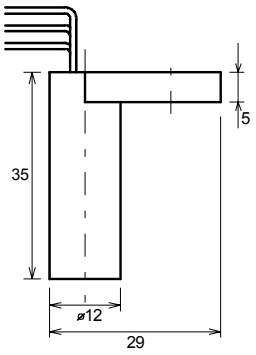
3.3.3 Proximity switch

In modernisation cases there might be proximity switch as pulse sensor of motor.
Inverter needs information about the motor rotation speed for stall, speed difference and overspeed supervision. Type markings of the speed supervision sensors (not needed in applications with bearing sensor or encoder) and fixing distance from the pulse wheel (air gap) are shown in the table below.

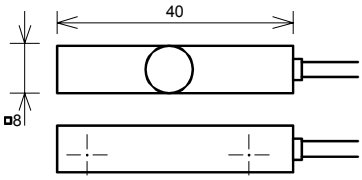
Proximity switch	air gap
Honeywell 3GT101DC	0.5 ... 1.0 mm
Schönbuch INSOR88 ICDM 8802	0.5 ± 0.1 mm
Baumer IFRM08N1501/L	0.5 ± 0.1 mm



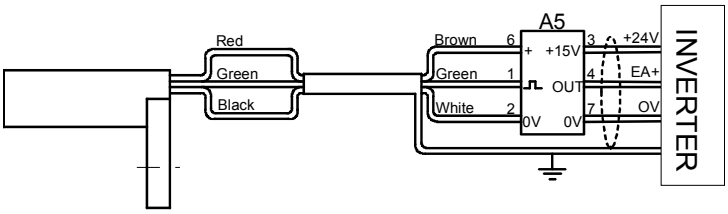
Honeywell 3GT101DC

Note that the Honeywell-sensor cable is lengthened and the wire colours are not equal to other sensors. However, colour markings corresponding to the other sensors have been added to wire ends (not necessarily, if cable has been shortened afterwards). The connection of Honeywell-sensor and the cable markings are shown in the table below.

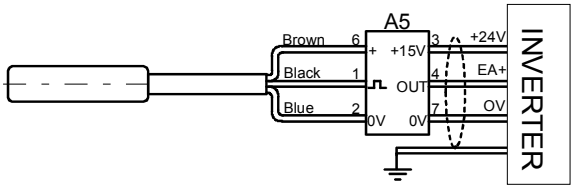
Signal name	Sensor	Cable	Colour marking	Terminal number
+24V	Red	Brown	Brown	KAE234:6
PULSE	Green	Green	Black	KAE234:1
0V	Black	White	Blue	KAE234:2

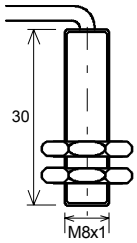


Schönbuch INSOR ICDM 8802



Honeywell 3GT101DC





Baumer IFRM08N1501/L

Note the following details
- buffer amplifier must be located as close the proximity switch as possible (maximum distance 3m)
- sensor cable must be located as far from the motor cables and braking resistor cable as possible (minimum distance > 20cm)

In order to avoid fault situations, the cable between the encoder and inverter must be
- as far as possible from the cables of motor and braking resistor (minimum distance >20cm)
- a shielded and twisted cable
- grounded (the shield) at both ends, 360° grounding on inverter terminal
- the shield should be grounded always when going through terminals

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Some problems may occur when using shielded flat cable or in situations where the encoder cable has been placed too close (< 5cm) to the motor cables and braking resistor cables. Cabling methods and distances determine the best way to ground the shielded cable; at both ends or only at one end.

Buffer amplifier pulse output can be measured during driving. If the pulse sequence is not uniform and for instance longer pulses occur every now and then, the reason may be one of following:
- an incorrect air gap (proximity switch)
- the sensor is not properly on the top of the pulse wheel (proximity switch)
- disturbances are transferred to the sensor cable
- the pulse wheel is faulty

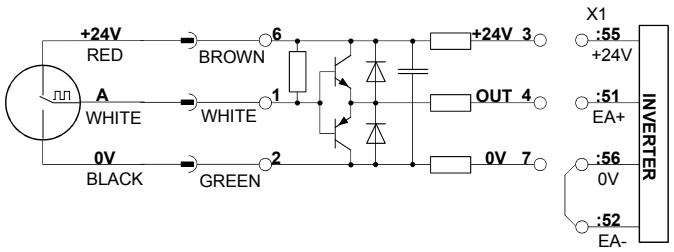
Honeywell 3GT101DC Hall-sensor requires tooth movement past the sensor. A motionless tooth can not generate a pulse.

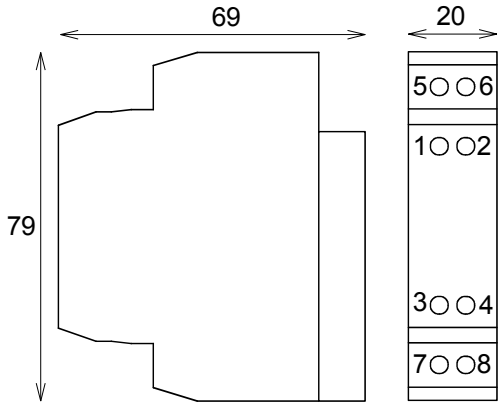
3.3.4 Buffer amplifier KAE234

The speed sensor (proximity switch or sensor bearing) is connected to inverter via KAE234 buffer amplifier. KAE234 must be located near the sensor (usually in the connection box of the hoist or the motor).

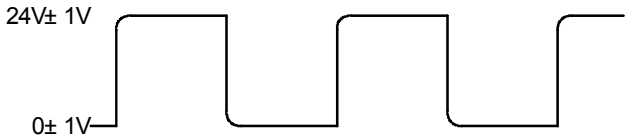
Without a buffer amplifier some faulty pulses could activate the speed supervision of inverter. Typically the problem would be a momentary lack of pulses or oscillations at the sensor output. Usually the noise sensitivity increases when the sensor temperature rises.

KAE234 connection with sensor bearing.





Buffer amplifier pulse output can be measured during driving. The picture beside presents the pulse output.



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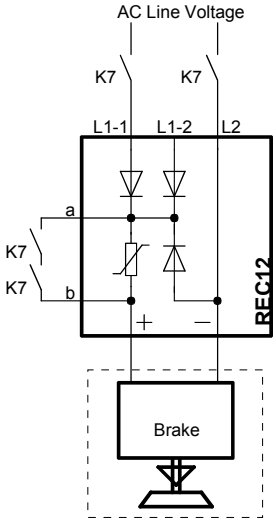
3.4 Brake controllers

3.4.1 REC12

Brake control unit REC12 is a line voltage half-wave rectifier for DC-brakes.

Voltage range	200...690Vac
Output voltage U_{DC}	Half wave 0.45 x U_{AC}
Maximum current	1.25Adc



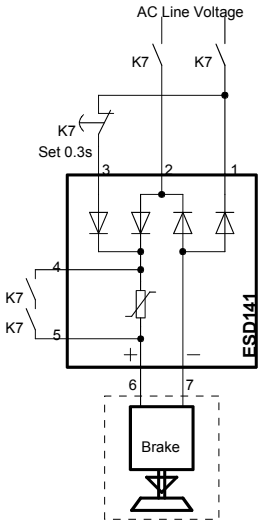
When the brake is opened, the brake contactor K7 connects two phases of mains voltage to terminals L1 and L2. In addition, the brake contactor shorts terminals a and b thus making the DC-circuit.

To close the brake, the brake contactor disconnects the supply to terminals L1 and L2. The released brake contactor also opens the brake coil DC-circuit, which speeds closing of the brake. The purpose of the varistor there is overvoltage protection for K7 contacts and the brake coil.

3.4.2 ESD141

Brake control unit ESD141 is a line voltage full/half-wave rectifier for DC-brakes.

Voltage range	200...690Vac
Output voltage U_{DC}	Full wave 0.90 x U_{AC}
	Half wave 0.45 x U_{AC}
Maximum current	1.25Adc continuous and 2.5Adc at ED5%



When the brake is opened, the brake contactor K7 connects two phases of mains voltage to terminals 1, 2 and 3, which makes the device a full wave rectifier. The full wave mode is used to get the brake open fast. In addition, the brake contactor shorts terminals 4 and 5 thus making the DC-circuit.

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After a time delay (normally 0.3s), the delayed contact of the brake contactor opens, which disconnects the supply from terminal 3 and the rectifier changes to a half wave type. Half wave operation prevents heating of the brake coil and is enough to keep the brake open.

To close the brake, the brake contactor disconnects the supply to terminals 1 and 2. The released brake contactor also opens the brake coil DC-circuit, which speeds closing of the brake. The purpose of the varistor there is overvoltage protection for K7 contacts and the brake coil.

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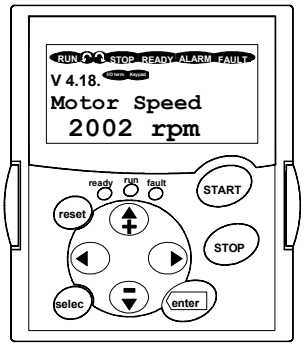
4 PARAMETER ADJUSTMENTS

4.1 The display panel



The display panel is used for:
- Displaying the drive identification, electrical values, operating or fault parameters
- Altering the parameter settings
- Saving and restoring the parameter settings in the memory of the display panel

Meaning of the displays:

RUN	Motor is running, blinks when ramping down.
	Direction of motor rotation.
STOP	Motor is not running.
READY	Power is on. In case of a trip, the symbol will not light up.
ALARM	Drive is running outside of certain limit.
FAULT	Fault is on
I/O term	I/O-terminals are the selected control place
Keypad	Keypad is the selected control place

The signalling LED's
"ready" Power is on.
"run" Motor is running, blinks when ramping down.
"fault" Fault trip
Button description

reset	Reset active faults
select	Switch between two latest displays
enter	Confirmation of selections Fault history reset
	Browse the main menu and the pages of submenus Edit values
	Move in menu Move cursor Enter and exit edit mode
START	Start button Starts motor if the keypad is the active control place

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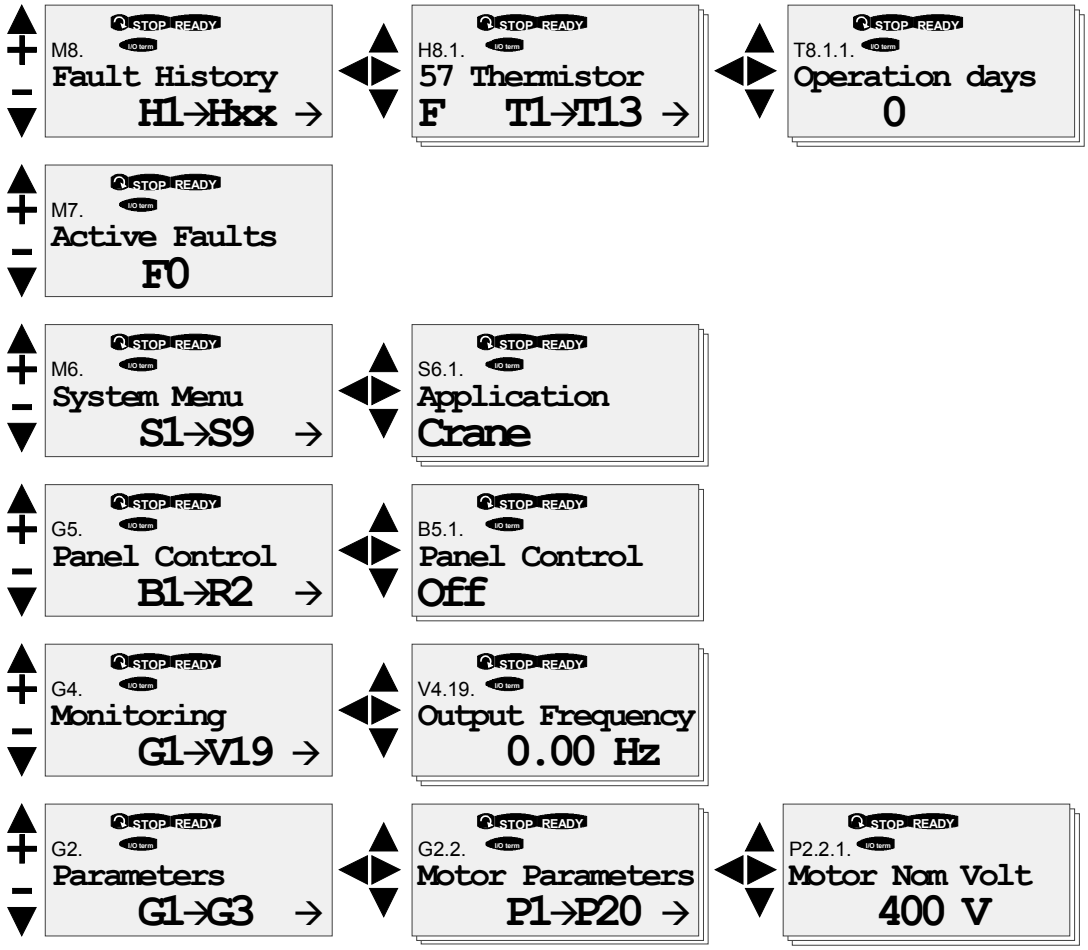
STOP	Stop button Stops the motor if keypad is the active control place

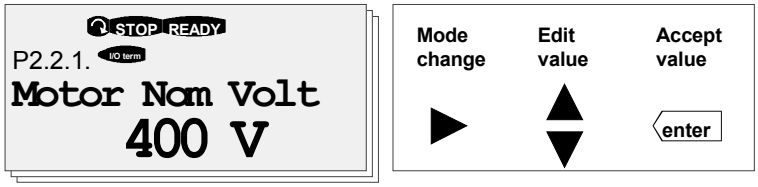
WARNING! Changing parameter settings during running may cause a hazardous situation. Parameter settings must not be changed during running.

WARNING! Driving via display may cause a hazardous situation. Panel control must not be used.

4.1.1 Navigation on the control keypad



4.1.2 Value line editing



WARNING! Changing parameter settings during running may cause a hazardous situation. Parameter settings must not be changed during running.

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4.2 Storing and restoring parameters

4.2.1 User parameters

- File “User parameters” is stored in inverter’s control unit.
- User parameters are recommended to save after final set up.
- The whole parameterset can be stored to User parameters with parameter B 4.1.2.
  “Save User Par / Enter <-“, press “Enter”
- Parameters can be restored from User parameters with parameter B 4.1.3.
  “Load User Par / Enter <-“, press “Enter”
- After restoring always check the motor parameters.

Parameters in use can be compared to User parameters by parameter S 6.6.2.

Parameters restored from User parameters are reseted after power off, unless they are not confirmed with “Enter” one by one. Easiest way to restore User parameters permanently is to compare parameters to User parameters by parameter S 6.6.2 and adjust them to the same value.

4.2.2 Default parameters

- File “Default parameters” is stored in inverter’s control unit.
- Default parameters are saved at the factory and they should not be changed. In default parameters there are the same parameter values as shown in parameter list delivered with inverter. Since serial number 03L50700
- Parameters can be restored from Default parameters with parameter B 4.1.1.
  “Load Default Par / Enter <-”, press “Enter”
- After restoring always check the motor parameters.
- Parameters in use can be compared to Default parameters by parameter S 6.6.1.
  Value “0” at parameter S 6.6.1. means that parameters in use are identical to Default parameters

Parameters restored from Default parameters are reseted after power off, unless they are not confirmed with “Enter” one by one. Easiest way to restore Default parameters permanently is to compare parameters to Default parameters by parameter S 6.6.1 and adjust them to the same value.

4.2.3 Keypad settings

- File “Keypad settings” is stored in keypad
- Default value for parameter P 6.5.4 is “On”. This makes every change to be stored to file “Keypad settings”.
- The whole parameterset can be stored to file “Keypad setting” with parameter S 6.5.1.
  “Up to keypad / Select ->”, press “->”
  “All param.” blinks on display, confirm with enter.
- Parameters can be restored from keypad’s file “Keypad settings” with parameter S 6.5.2.
  “Down from keypad / Select ->”, press “->”
  “All param.” blinks on display, confirm with enter.
- After restoring always check the motor parameters.

4.2.4 Factory settings

- Factory settings are not used.

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5 PARAMETER DESCRIPTIONS

This manual describes parameters with software Ind2V081. Under control panel there is sticker for software version.

Parameters are assorted to Groups. All Groups are not always listed in control panel. Groups are shown in control panel according to password level and selected functions. This feature makes visible parameter menu simple and only needed parameters are shown.

Letter front of the code number describes variable type		
A = Application	E = Expander	R = Reference
B = Button	G =Group	S = System
C = Counter	I = Info	T = Trip Counter
D = DynACode	P = Parameter	V = Value

Label	Code	Function/Description	Adjustment range	
G2.1 General Parameters				
Password	P2.1.1	Default 768 Service 2156, shows also group G2.3. Expert		
Supply Voltage	V2.1.2	Power unit nominal voltage	F 380V – 500V	
Device	V2.1.3	Device	Industrial	
Input Set	P2.1.4	Input Set selection, see chapter “Control methods”	1 =	EP
			2 =	EP3
			3 =	Multistep
Analog Input Sel	P2.1.5	Analog input selection	0 =	Not used
			1 =	Multicare
			2 =	Load
			3 =	Multicare&Load
Slow speed freq	P2.1.6	Speed when one of slow down limit switches (S11/S21) is open	0 – 250 Hz	
Multistep 2 freq	P2.1.7	2nd preset speed. Multistep speed setting.	0 – 250 Hz	
Multistep 3 freq	P2.1.8	3rd preset speed. Multistep speed setting.	0 – 250 Hz	
Multistep 4 freq	P2.1.9	4th preset speed. Multistep speed setting.	0 – 250 Hz	
Accel Time 1	P2.1.10	Acceleration ramp is defined from zero to motor nominal frequency P2.2.2. Shorter values than the factory setting must not be used.	1-300 s	
Decel Time 1	P2.1.11	Deceleration ramp is defined from motor nominal frequency P2.2.2 to zero. Shorter values than the factory setting must not be used.	1-300 s	

G2.1.12 Multicare			
Test Voltage Min	B2.1.12.1	1.00V is given to Analog output Aout2 by this button.	Off / On
Test Voltage Max	B2.1.12.2	9.00V is given to Analog output Aout2 by this button.	Off / On
Ain 1 Value	V2.1.12.3.	Value of analog input Ain1 voltage	V
Min Value Volt 1	P2.1.12.4.	Ain1 value when test voltage min has been selected in the other drive.	0 – 10 V
Max Value Volt 1	P2.1.12.5.	Ain1 value when test voltage max has been selected in the other drive.	0 – 10 V

G2.2 Motor Parameters			
Motor Nom Volt	P2.2.1	Nominal motor voltage Un from motor rating plate.	0 – 750 V
Motor Nom freq	P2.2.2	Nominal motor frequency fn from motor rating plate	0 – 250 Hz
Motor Nom Speed	P2.2.3	Nominal motor speed n from motor rating plate	0 – 6000 rpm
Motor Nom Curr	P2.2.4	Nominal motor current In from motor rating plate. In multimotor drives nominal currents must be summarized.	
Nom Flux Curr	P2.2.5	Motor nominal flux current Io, same as no-load current or magnetizing current from motor rating plate. In multimotor drives nominal flux currents must be summarized.	

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Start Current	P2.2.6	Start current. Current level, which is used in motor starting situation. Hoisting application: default value is motor's nominal current, but not over nominal current of the inverter.		
Current Limit	P2.2.7	Defines the maximum motor current from the inverter. If the output current exceeds the value set in parameter P2.2.7 the output frequency is lowered until the current drops below the current limit. The rate of lowering the frequency depends on the current overshoot. To avoid motor overloading, set this parameter according to the rated current of the motor (normally 1,5....2xI_n). In multimotor drives nominal currents must be summarized. Note! The value must be limited to Drive maximum output current (1 minute value).		
Min Freq S1	P2.2.8	Minimum frequency direction 1. Hoisting application: Smaller value than factory setting is not allowed to use	0 – Max Freq S2, Hz	
Min Freq S2	P2.2.9	Minimum frequency direction 2. Hoisting application: Smaller value than factory setting is not allowed to use	0 – Max Freq S2, Hz	
Max Freq S1	P2.2.10	Maximum frequency direction 1.	0 – 250 Hz	
Max Freq S2	P2.2.11	Maximum frequency direction 2.	0 – 250 Hz	
Max ESR freq	P2.2.12	Maximum frequency when ESR activated	0 – 250 Hz	
Drive Selection	P2.2.13	Application selection, selection None causes F60 Parameter fault.	0 =	None
			1 =	Travel
			2 =	Hoist
Pulse Number	P2.2.14	Pulse wheel pulse number.	0 =	24
			1 =	36
			2 =	48
			3 =	72
			4 =	32
			5 =	64
			6 =	80
			7 =	102
			8 =	600
			9 =	1000
			10 =	1024
			11 =	2000
Zero Freq Volt	P2.2.15	Output voltage at zero frequency, % of motor nominal voltage.	0 – 40 %	
U/f Mid Volt	P2.2.16	Voltage in the selected middle point frequency, % of motor nominal voltage.	0 – 100 %	
U/f Mid Freq	P2.2.17	Middle point frequency.	0 – 250 Hz	
Torque Boost	P2.2.18	Torque maximization.	0 =	Off
			1 =	On
RS Voltage Drop	P2.2.19	Relative value of motor stator impedance voltage drop. Value of this parameter is calculated by formula given below. $\frac{\text{Motor Nom Flux current x Measured motor resistance (phase to phase) x 2217}}{\text{Motor nominal voltage}}$	0 – 512	
Stop Function	P2.2.20	Stopping mode selection Ramping: When the drive command is switched off the motion is stopped according to the set deceleration ramp. Brake: When the drive command is switched off the motor current is cut off and the motion is stopped by the mechanical brake.	0 =	Brake
			1 =	Ramping

G2.3 Expert			
Flux Current Kp	P2.3.1	Gain for flux current control. Too small or too large value results oscillation in the current control. Must not be changed.	0 - 32000
Flux Current Ti	P2.3.2	The integration time of the flux current control. Too small or too large value results oscillation in the current control. Must not be changed.	0 – 1000 ms
S2 Flux Control	P2.3.3	Increases or decreases the Flux Current controller values P2.3.1&2 to direction S2. Must not be changed. Used in hoisting application.	0 – 100 %

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Freq 0	P2.3.4	Constant current mode frequency limit in percentage of nominal frequency. Between 0 Hz and Freq 0 current control keeps motor current in value of P2.3.12 Zero Speed Current.	0 – 100 %
Freq 1	P2.3.5	Flux current mode frequency limit in percentage of nominal frequency. Between frequencies Freq 1 and Freq 2 drive is controlled with special flux current control method.	0 – 100 %
Freq 2 S1	P2.3.6	Mixed current/voltage mode frequency limit in percentage of nominal frequency in direction S1. Must not be changed.	0 – 100 %
Freq 3 S1	P2.3.7	U/f-control mode frequency limit in percentage of nominal frequency in direction S1. Must not be changed.	0 – 100 %
Zero Flux Curr	P2.3.8	Relative value of flux current of motor. Typical value of this current control method is 80 %. Parameter is not related to motor real physical values. Must not be changed.	0 – 100 %
Stray Flux Curr	P2.3.9	Relative value of stray flux current of motor. Typical value of this current control method is 40 %. Parameter is not related to motor real physical values. Must not be changed.	0 – 100 %
Freq 2 S2	P2.3.10	Mixed current/voltage mode frequency limit in percentage of nominal frequency in direction S2. Must not be changed.	0 – 100 %
Freq 3 S2	P2.3.11	U/f-control mode frequency limit in percentage of nominal frequency in direction S2. Must not be changed.	0 – 100 %
Zero Speed Curr	P2.3.12	Relative value of motor current used in small frequencies % of motor nominal current. Must not be changed.	0 – 250 %
Min Current Ref	P2.3.13	Minimum value of motor current used in current control area % of motor nominal current. Must not be changed.	0 – 100 %
Accel Comp TC	P2.3.14	Acceleration compensation time constant, which describes rotating masses of drive system. Physical description of this parameter is a time, which is needed to accelerate rotating masses from zero to nominal frequency with motor nominal torque. Must not be changed.	0 – 300 s
Ref Angle S1	P2.3.15	Voltage / current angle difference S1. 1536 equals 90 angle. Used in direction changes. Must not be changed.	0 – 3000
Ref Angle S2	P2.3.16	Voltage / current angle difference S2. 1536 equals 90 angle. Used in direction changes. Must not be changed.	0 – 3000
Flux Curr Damp	P2.3.17	Flux Current Ctrl stabilator time constant in milliseconds. Must not be changed.	0 – 400 ms
Stop DC-Freq	P2.3.18	Defines the frequency at witch DC-braking starts.	0 – 250 Hz
Start Freq S1	P2.3.19	Defines the output frequency during brake opening delay to direction S1.	0 - Max Freq S2, Hz
Start Freq S2	P2.3.20	Defines the output frequency during brake opening delay to direction S2.	0 - Max Freq S2, Hz
Brake Stop Freq	P2.3.21	When stopping the contact of the relay output ROB2 opens when the output frequency of drive goes below the value set in this parameter.	0 - Max Freq S2, Hz
ESR Point Freq	P2.3.22	Defines ESR (field weakening) point frequency in percents of motor nominal frequency.	0 – 250 %
ESR Point Volt	P2.3.23	Defines ESR (field weakening) point voltage in percents of motor nominal voltage.	0 – 250 %
IrAdd Motor	P2.3.24	With small speeds and heavy load the hoist movement does not have enough voltage to produce sufficient torque. Raising the value of this parameter increases the voltage. Must not be changed.	0 – 200 %
IrAdd Generator	P2.3.25	If motor voltage at generator area is too high, reducing value of parameter decreases the voltage.	0 – 200 %
Ramp Stretching	P2.3.26	See *Chapter* "*Ramp Stretching*". Not used in hoisting	0 – 50 %
Switching Frequency	P2.3.27	Must not be changed from factory setting	3.6 kHz
DeadTime Comp	P2.3.28	Dead time compensation time delay. Parameter value does not tell the actual time used in compensation.	0 – 10000
DeadTime CurrLim	P2.3.29	Parameter that is used to control the current waveform in dead time compensation.	0 – 1000
Brake Chopper	P2.3.30	Defines when braking chopper is allowed to be activated. Always while drive is in ready state or only while running.	1 = Yes (Run) 0 = Yes (Ready)

G4. Monitoring			
G4.1 Parameter backup			
Load Default Par	B4.1.1	Restores Default Parameters to Active Parameters from the Control Unit memory. Default Parameters are the parameters, which have been saved in the factory.	

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Save User Par	B4.1.2	Saves Active Parameters in the Control Unit as User Parameters. Final parameters for the application must be saved as User Parameters after start-up.	
Load User Par	B4.1.3	Restores User Parameters to Active Parameters from the control unit memory. User Parameters are the parameters, which have been saved after start-up.	

G4.1.4 Factory Default			
Save Default Par	B4.1.4.1	Saves Active Parameters in the Control Unit as Default Parameters. Default Parameters are the parameters, which must be saved in the factory. **For factory use only.**	

G4.2 Analog I/O			
Ain1 Value	V4.2.1	Value of analog input Ain1	0 – 10 V
Ain2 Value	V4.2.2	Value of analog input Ain2	0 – 10 V
Aout1 Value	V4.2.3	Value of analog output Aout1	0 – 20 mA
Aout2 Value	V4.2.4	Value of analog output Aout2	0 – 10 V

G4.3 Relay output			
ROB1 State	V4.3.1	State of relay output ROB1	0=OFF, 1=ON
ROB2 State K7	V4.3.2	State of relay output ROB2, K7	0=OFF, 1=ON
ROC1 State	V4.3.3	State of relay output ROC1	0=OFF, 1=ON
ROD1 State	V4.3.4	State of relay output ROD1	0=OFF, 1=ON
ROE1 State	V4.3.5	State of relay output ROE1	0=OFF, 1=ON
ROE2 State	V4.3.6	State of relay output ROE2	0=OFF, 1=ON
ROE3 State	V4.3.7	State of relay output ROE3	0=OFF, 1=ON

G4.4 Operate counters
Not used

G4.5. Fault Counter			
Fault Counter	V4.5.1. – 4.5.24	Fault counter value.	
Total Faults	V4.5.25	Total number of all faults	

G4.7. Digital Input								
S1	V4.7.1.1.	State of digital input S1						0=OFF, 1=ON
S2	V4.7.1.2.	State of digital input S2						0=OFF, 1=ON
DIA3	V4.7.1.3.	State of digital input DIA3						0=OFF, 1=ON
DIA4	V4.7.1.4.	State of digital input DIA4						0=OFF, 1=ON
DIA5	V4.7.1.5.	State of digital input DIA5						0=OFF, 1=ON
OK	V4.7.1.6.	State of digital input OK						0=OFF, 1=ON
DID1	V4.7.1.7.	State of digital input DID1						0=OFF, 1=ON
DID2	V4.7.1.8.	State of digital input DID2						0=OFF, 1=ON
DID3	V4.7.1.9.	State of digital input DID3						0=OFF, 1=ON
DID4	V4.7.1.10.	State of digital input DID4						0=OFF, 1=ON
DID5	V4.7.1.11.	State of digital input DID5						0=OFF, 1=ON
Basic Board	V4.7.3.	State of board A inputs Corresponding X1 terminals	S1 8	S2 9	DIA3 10	DIA4 11	DIA5 12	0=OFF, 1=ON
Extension Board	V4.7.4.	State of board D inputs Corresponding X1 terminals	DID1 38	DID2 39	DID3 40	DID4 41	DID5 42	0=OFF, 1=ON

G4.8. SSU

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Overspd Lim 1	V4.8.1.	Overspeed limit 1 level. Percent of Max Freq S2	0 – 140 %
Overspd Lim 2	V4.8.2.	Overspeed limit 2 (ESR) value. Percent of Max Freq S2	0 – 140 %

G4.9. Service			
Phase U Curr	V4.9.1.	Phase U current of inverter output	A
Phase V Curr	V4.9.2.	Phase V current of inverter output	A
Phase W Curr	V4.9.3.	Phase W current of inverter output	A
Encoder Speed	V4.9.4.	Pulse frequency from pulse sensor	Hz
HeatSinkTempMax	V4.9.5.	Recorded heatsink temperature highest peak value during run.	°C
HeatSinkTempMin	V4.9.6.	Recorded heatsink temperature lowest peak value when power is connected to drive.	°C
IGBT Temp Max	V4.9.7.	Recorded calculated IGBT temperature highest peak value.	°C
IGBT Temperature	V4.9.8.	Actual IGBT temperature	°C
SlipAdjustChange	V4.9.9.	Slip adjust difference compared to Slip adjust parameter.	%

G4.10 Max Current.			
Max Current	V4.9.10.1.	Recorded maximum current	A
Max Current Freq	V4.9.10.2.	Frequency at recorded maximum current.	Hz
Max Current Torq	V4.9.10.3.	Torque at recorded maximum current.	%
Freq Ref	V411.	Frequency reference	Hz
Speed Req	V4.12.	Not used.	
Distance counter	V4.13.	Not used	m
DC-Link Voltage	V4.14.	Actual value of measured DC-link voltage.	V
Heat Sink Temp	V4.15.	Temperature of heat sink.	°C
MotorTemperature	V4.16.	Calculated motor temperature in percent of maximum	%
Motor Power	V4.17.	Calculated actual power. % of nominal power of unit	%
Motor Voltage	V4.18.	Calculated motor voltage	V
Motor Torque	V4.19.	Calculated motor torque +/- motor nominal torque, positive when motoring, negative when generating.	%
Motor Current	V4.20.	Measured motor current	A
Motor Speed	V4.21.	Calculated motor speed	rpm
Output Frequency	V4.22.	Output frequency to the motor	Hz

G4.23 Multimonitor			
Multimonitor	N4.23.1.	Multimonitor page shows motor current, motor voltage and putput frequency in display in the same time. Monitor variables can be changed if parameter P6.5.4. = ChangeEnable	

G5 Panel Control			
Panel Control	B5.1.	Must not be used.	Off, On
Speed Reference	R5.2.	Speed reference for panel control	

M6 System Menu			
Language	S6.1.	Keypad language	English
Application	S6.2.	Application	Crane

S6.3. Copy Parameters			
Parameter Sets	S6.3.1.	Not used, see parameter group G4.1. Parameter backup	
Up to keypad	S6.3.2.	Save parameter settings up to keypad	
Down from keypad	S6.3.3.	Download parameter settings down from keypad	

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Autom. BackUp	P6.3.4.	Changes in parameters are automatically saved to Keypad settings	Yes / No

S6.4. ParamComparison			
Set 1	S6.4.1.	Actual parameter values are compared to Default parameters. Value of parameters can also be changed in this display.	Par. No. = Default val. Actual value
Set 2	S6.4.2.	Actual parameter values are compared to file User parameters. Value of parameters can also be changed in this display.	Par. No. = User val. Actual value
Factory settings	S6.4.3.	Parameter file Factory settings is not used	
Keypad set	S6.4.4.	Actual parameter values are compared to parameter file saved in Keypad.	

S6.5. Security			
Password	S6.5.1	Password for group S6.5.	
Parameter lock	P6.5.2	Not used	Change Enable
Startup wizard	P6.5.3.	Not used	No
Multimon. Items	P6.5.4.	Enables or disables chancing of variables in multimonitor page N4.23.1.	ChangeEnable ChangeDisable

S6.6. Keypad settings			
Default page	P6.6.1.	Default page to which the display automatically moves as the Timeout time has expired or as the power is switched on to the keypad. If the Default Page value is 0 the function is not activated, i.e. the last displayed page remains on the keypad display.	
Default page/OM	P6.6.2.		
Timeout time	P6.6.3.	The time after which the keypad display returns to default page.	
Contrast	P6.6.4.	Display contrast.	
Backlight time	P6.6.5.	Determines how long the backlight stays before going out. Value “0” means Forever.	0 – 65535 min

S6.7. HW settings			
InternBrake Res	P6.7.1.	Must not be changed.	Not conn.
Fan Control	P6.7.2.	Must not be changed.	First start
HMI ACK timeout	P6.7.3	Not used	
HMI retry	P6.7.4.	Not used	

S6.8. System Info			
S6.8.1. Total counters			
MWh counter	C6.8.1.1.	MWh counter, can not be reseted	
PwOn Day Counter	C6.8.1.2.	Total number of power on days	
PwOn hour count.	C6.8.1.3.	Total number of power on hours	

S6.8.2. Trip counters			
MWh Counter	T6.8.2.1.	MWh counter, can be reseted	
Clr MWh Counter	P6.8.2.2.	Clear MWh counter T6.8.2.1.	Not reset / Reset
PwOn Day Counter	T6.8.2.3.	Number of power on days	
PwOn hour count.	T6.8.2.4.	Number of power on hours	
Clr Optime cntr	T6.8.2.5.	Clear trip counters T6.8.2.1. – T6.8.2.4.	

S6.8.3. Software			
Software package	I6.8.3.1.	See software sticker under display, IND2V081	NXP_IND2V081
SystemSw version	I6.8.3.2.		12.47.9072
Firmware interf.	I6.8.3.3.		4.53
System load	I6.8.3.4.	Load of CPU	%

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S6.8.4. Applications			
A6.8.4.1. Crane			
Application id	D6.8.4.1.1.	See software sticker under display, IND**2**V081	Industr2
Version	D6.8.4.1.2.	See software sticker under display, IND2V**081**	8.10
Firmware interf.	D6.8.4.1.3.		4.49

S6.8.5. Hardware			
Power unit	I6.8.5.1.	Power unit id code	
Unit voltage	I6.8.5.2.	Nominal voltage of D2V	500V
Brake chopper	E6.8.5.3.	There is brake chopper in D2V	Yes
Brake resistor	E6.8.5.4.	No braking resistor inside D2V	No
Serial number	E6.8.5.5.	Serial number of CSU	

S6.8.6. Expander boards			
E6.8.6.1. A:NXOPTA6			
State	E6.8.6.1.1.	State of board in slot A	Run
Program version	E6.8.6.1.2.	Program version of board in slot A	0.0
E6.8.6.2. B:NXOPTA3			
State	E6.8.6.2.1.	State of board in slot B	Run
Program version	E6.8.6.2.2.	Program version of board in slot B	10005.0
E6.8.6.3. C:SSU			
State	E6.8.6.3.1.	State of board in slot B	Run
Program version	E6.8.6.3.2.	Program version of board in slot B	10503.14
E6.8.6.4. D:NXOPTB9			
State	E6.8.6.4.1.	State of board in slot B	Run
Program version	E6.8.6.4.2.	Program version of board in slot B	10501.4
E6.8.6.5. E: No board			

S6.8.7. Debug
Not used

S6.9. Power monitor			
IU filtered	V6.9.1.	U phase current	A
IV filtered	V6.9.2.	V phase current	A
IW filtered	V6.9.3.	W phase current	A
U Temperature	V6.9.4.	Phase U temperature	°C
V Temperature	V6.9.5.	Phase V temperature	°C
W Temperature	V6.9.6.	Phase W temperature	°C
Card Temperature	V6.9.7.	Card temperature	°C

S6.11 Power multimon.			
Power multimonitor	V6.11.1.	Output current values and power card temperature	

M7 Active faults			
		The memory of active faults can store the maximum of 10 faults in the order of appearance. By pushing the ⊙ button you will enter the Fault time data record menu indicated by T.1-T.13. In this menu some selected important, data valid at the time of the fault, are recorded.	
	T.1	Counted operation days	d
	T.2	Counted operation hours	hh:mm:ss

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	T.3	Output frequency	Hz
	T.4	Motor current	A
	T.5	Motor voltage	V
	T.6	Motor power	%
	T.7	Motor torque	%
	T.8	DC voltage	V
	T.9	Unit temperature	°C
	T.10	Ready Run	0=Not Ready 1=Ready 0=Not Running 1=Run
	T.11	Direction Fault	0=Off 1=On 0=No 1=Yes
	T.12	Warning At reference	0=No 1=Yes 0=No 1=Yes
	T.13	0-speed	0=Not Zero Speed 1=Zero Speed

M8 Fault history			
		The fault memory can store a maximum of 30 faults in the order of appearance. The number of faults currently in the fault history is shown on the value line of the main page. The order of the faults is indicated by the location indication in the upper left corner of the display. The latest fault carries the indication F8.1, the second latest F8.2 etc. The Fault time data record pages are accessible at each fault. If there are 30 uncleared faults in the memory, the next occurring fault will erase the oldest from the memory. Pressing the Enter button for about 2 to 3 seconds resets the whole fault history.	

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6 FACTORY DEFAULT PARAMETERS

6.1 Factory default parameters for 100Hz motors

002		
T1, MF10MA200, 400V 100Hz		
Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	400
P 2.2.2	Motor Nom Freq	100
P 2.2.3	Motor Nom Speed	2830
P 2.2.4	Motor Nom Curr	4.8
P 2.2.5	Nom Flux Curr	3.2
P 2.2.6	Start Current	5.8
P 2.2.7	Current Limit	10
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	100
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	32
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	8
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	200
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	20
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	20
P 2.3.12	Zero Speed Curr	120
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	1536
P 2.3.17	Flux Curr Damp	40
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1.5
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	2
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

004		
T2, MF10MB200, 400V 100Hz		
Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	400
P 2.2.2	Motor Nom Freq	100
P 2.2.3	Motor Nom Speed	2790
P 2.2.4	Motor Nom Curr	9.4
P 2.2.5	Nom Flux Curr	6.2
P 2.2.6	Start Current	10
P 2.2.7	Current Limit	15
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	100
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	32
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	7
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	240
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	20
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	20
P 2.3.12	Zero Speed Curr	110
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	1536
P 2.3.17	Flux Curr Damp	40
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1.5
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	2
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

005		
T3, MF10MC200, 400V 100Hz		
Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	400
P 2.2.2	Motor Nom Freq	100
P 2.2.3	Motor Nom Speed	2780
P 2.2.4	Motor Nom Curr	10.7
P 2.2.5	Nom Flux Curr	6.3
P 2.2.6	Start Current	12.9
P 2.2.7	Current Limit	16
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	100
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	32
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	6.5
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	190
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	30
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	20
P 2.3.12	Zero Speed Curr	120
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	1536
P 2.3.17	Flux Curr Damp	40
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1.5
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	1.5
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

007		
T4, MF11MA200, 400V 100Hz		
Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	400
P 2.2.2	Motor Nom Freq	100
P 2.2.3	Motor Nom Speed	2860
P 2.2.4	Motor Nom Curr	18
P 2.2.5	Nom Flux Curr	12
P 2.2.6	Start Current	18
P 2.2.7	Current Limit	27
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	100
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	64
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	7
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	130
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	20
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	40
P 2.3.12	Zero Speed Curr	110
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	2000
P 2.3.17	Flux Curr Damp	200
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1.5
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	1
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

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T5, 011		
MF11MB200, 400V 100Hz		
Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	400
P 2.2.2	Motor Nom Freq	100
P 2.2.3	Motor Nom Speed	2830
P 2.2.4	Motor Nom Curr	21
P 2.2.5	Nom Flux Curr	12
P 2.2.6	Start Current	24
P 2.2.7	Current Limit	31
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	100
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	63
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	8
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	150
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	20
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	40
P 2.3.12	Zero Speed Curr	110
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	2000
P 2.3.17	Flux Curr Damp	200
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1.5
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	1
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

T6, 015		
MF13Z-200, 400V 100Hz		
Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	400
P 2.2.2	Motor Nom Freq	100
P 2.2.3	Motor Nom Speed	2910
P 2.2.4	Motor Nom Curr	31
P 2.2.5	Nom Flux Curr	15
P 2.2.6	Start Current	32
P 2.2.7	Current Limit	46
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	100
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	80
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	8
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	180
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	20
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	40
P 2.3.12	Zero Speed Curr	110
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	2000
P 2.3.17	Flux Curr Damp	200
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	1
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

T7, 018		
MF13ZA200, 400V 100Hz		
Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	400
P 2.2.2	Motor Nom Freq	100
P 2.2.3	Motor Nom Speed	2890
P 2.2.4	Motor Nom Curr	36
P 2.2.5	Nom Flux Curr	15
P 2.2.6	Start Current	42
P 2.2.7	Current Limit	54
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	100
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	80
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	8
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	180
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	20
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	40
P 2.3.12	Zero Speed Curr	110
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	2000
P 2.3.17	Flux Curr Damp	200
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	1
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

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6.2 Factory default parameters for 120Hz motors

T1, 002		
MF10MA200, 460V 120Hz		
Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	460
P 2.2.2	Motor Nom Freq	120
P 2.2.3	Motor Nom Speed	3420
P 2.2.4	Motor Nom Curr	4.9
P 2.2.5	Nom Flux Curr	3.2
P 2.2.6	Start Current	5.8
P 2.2.7	Current Limit	10
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	120
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	32
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	8
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	200
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	20
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	20
P 2.3.12	Zero Speed Curr	120
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	1536
P 2.3.17	Flux Curr Damp	40
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1.5
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	2
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

T2, 004		
MF10MB200, 460V 120Hz		
Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	460
P 2.2.2	Motor Nom Freq	120
P 2.2.3	Motor Nom Speed	3370
P 2.2.4	Motor Nom Curr	9.3
P 2.2.5	Nom Flux Curr	6.2
P 2.2.6	Start Current	10
P 2.2.7	Current Limit	15
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	120
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	32
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	7
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	240
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	20
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	20
P 2.3.12	Zero Speed Curr	110
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	1536
P 2.3.17	Flux Curr Damp	40
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1.5
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	2
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

T3, 005		
MF10MC200, 460V 120Hz		
Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	460
P 2.2.2	Motor Nom Freq	120
P 2.2.3	Motor Nom Speed	3340
P 2.2.4	Motor Nom Curr	11
P 2.2.5	Nom Flux Curr	6.3
P 2.2.6	Start Current	12.9
P 2.2.7	Current Limit	16
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	120
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	32
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	6.5
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	190
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	30
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	20
P 2.3.12	Zero Speed Curr	120
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	1536
P 2.3.17	Flux Curr Damp	40
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1.5
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	1.5
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

T4, 007		
MF11MA200, 460V 120Hz		
Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	460
P 2.2.2	Motor Nom Freq	120
P 2.2.3	Motor Nom Speed	3440
P 2.2.4	Motor Nom Curr	19
P 2.2.5	Nom Flux Curr	12
P 2.2.6	Start Current	18
P 2.2.7	Current Limit	27
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	120
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	64
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	7
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	130
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	20
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	40
P 2.3.12	Zero Speed Curr	110
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	2000
P 2.3.17	Flux Curr Damp	200
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1.5
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	1
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

011
T5, MF11MB200, 460V 120Hz

015
T6, MF13Z-200, 460V 120Hz

018
T7, MF13ZA200, 460V 120Hz

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Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	460
P 2.2.2	Motor Nom Freq	120
P 2.2.3	Motor Nom Speed	3410
P 2.2.4	Motor Nom Curr	22
P 2.2.5	Nom Flux Curr	12
P 2.2.6	Start Current	24
P 2.2.7	Current Limit	31
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	120
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	64
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	8
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	150
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	20
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	40
P 2.3.12	Zero Speed Curr	110
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	2000
P 2.3.17	Flux Curr Damp	200
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1.5
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	1
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	460
P 2.2.2	Motor Nom Freq	120
P 2.2.3	Motor Nom Speed	3500
P 2.2.4	Motor Nom Curr	31
P 2.2.5	Nom Flux Curr	15
P 2.2.6	Start Current	32
P 2.2.7	Current Limit	46
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	120
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	80
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	8
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	180
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	20
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	40
P 2.3.12	Zero Speed Curr	110
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	2000
P 2.3.17	Flux Curr Damp	200
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	1
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

Label	Code	Default
G 2.1. General Parameters		
P 2.1.10	Accel Time 1	2.5
P 2.1.11	Decel Time 1	2.5
G 2.2. Motor Parameters		
P 2.2.1	Motor Nom Volt	460
P 2.2.2	Motor Nom Freq	120
P 2.2.3	Motor Nom Speed	3480
P 2.2.4	Motor Nom Curr	37
P 2.2.5	Nom Flux Curr	15
P 2.2.6	Start Current	42
P 2.2.7	Current Limit	54
P 2.2.8	Min Freq S1	10
P 2.2.9	Min Freq S2	5
P 2.2.10	Max Freq S1	120
P 2.2.11	Max Freq S2	120
P 2.2.12	Max ESR Freq	120
P 2.2.13	Drive Selection	Hoist
P 2.2.14	Pulse Number	80
P 2.2.15	Zero Freq Volt	0
P 2.2.16	U/f Mid Volt	8
P 2.2.17	U/f Mid Freq	0
P 2.2.18	Torque Boost	On
P 2.2.19	Rs Voltage Drop	180
P 2.2.20	Stop Function	Ramping
G 2.3. Expert		
P 2.3.1	Flux Current Kp	4000
P 2.3.2	Flux Current Ti	25
P 2.3.3	S2 Flux Control	100
P 2.3.4	Freq 0	1
P 2.3.5	Freq 1	3
P 2.3.6	Freq 2 S1	10
P 2.3.7	Freq 3 S1	20
P 2.3.8	Zero Flux Curr	80
P 2.3.9	Stray Flux Curr	40
P 2.3.10	Freq 2 S2	10
P 2.3.11	Freq 3 S2	40
P 2.3.12	Zero Speed Curr	110
P 2.3.13	Min Current Ref	90
P 2.3.14	Accel Comp TC	0.1
P 2.3.15	Ref Angle S1	768
P 2.3.16	Ref Angle S2	2000
P 2.3.17	Flux Curr Damp	200
P 2.3.18	Stop DC-Freq	1.5
P 2.3.19	Start Freq S1	1
P 2.3.20	Start Freq S2	0.5
P 2.3.21	Brake Stop Freq	1
P 2.3.22	ESR Point Freq	120
P 2.3.23	ESR Point Volt	120
P 2.3.24	IrAdd Motor	100
P 2.3.25	IrAdd Generator	100
P 2.3.26	Ramp Stretching	0
P 2.3.27	Switching Freq	3.6
P 2.3.28	DeadTime Comp	2200
P 2.3.29	DeadTimeCurrLim	100
P 2.3.30	Brake Chopper	Run

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7 SPEED SUPERVISION SETTINGS

SSU is a hoist motion speed supervision unit, which reads the pulse frequency from the hoist motor sensor bearing, encoder or pulse sensor. This pulse frequency is compared with a fixed oscillator frequency and inverter frequency reference. As a result of frequency comparison, there are three different speed supervision functions available:

- overspeed supervision (rush control)
- stall supervision
- speed difference supervision

Overspeed supervision (F61) is totally implemented by hardware.
Switches S2-2 and S2-3 divide the full frequency range to four frequency areas.
Selected frequency area is the same for normal and ESR speeds.

The four frequency areas are each divided to lower and upper frequency ranges
Switch S2-1 selects the frequency range at normal speed.
Switch S2-4 selects the frequency range at ESR speed (Extended Speed Range).

The exact tripping frequency level is selected with rotary switches.
Switch S1 sets the tripping level at normal speed (value shown in V4.8.1).
Switch S3 sets the tripping level at ESR speed (value shown in V4.8.2).

Overspeed tripping levels are shown at display as % of the nominal speed. The overspeed setting should be 15-25% above the full speed.

Switches S2-2 and S2-3 select range for overspeed detection level. Range of detection level is the same for both, normal and ESR (Extended Speed range) use.

Fine adjustment for normal use is done by rotary switch S1 and switch S2-1.
Fine adjustment for ESR use is done by rotary switch S3 and switch S2-4.

Overspeed detection levels are shown at display panel as % of nominal speed. Overspeed setting should be 15-25% above the full speed.
Adjusted overspeed detection level for normal use is shown in parameter V4.8.1.
Adjusted overspeed detection level for ESR use is shown in parameter V4.8.2.

Speed difference supervision (F62) compares the motor actual speed (= pulse frequency) with Drive frequency reference. In practice this means that the motor slip is measured and if that exceeds a limit, supervision stops the motion.

Stall supervision (F63) stops the motion if there are no pulses coming from the sensor when the brake is open (K7 energised).

SSU relay test (F64): SSU Relay is tested in every power up. Driving is prevented if fault has been detected.

SSU Watchdog fault (F65): Communication between SSU board and control board is tested once in 50ms. Fault will be detected if there is communication error. When a fault is detected the drive is stopped.

SSU Overspeed Limit (F66): maximum setting of overspeed limit is 1.4×maximum speed of direction S2. Fault will be detected if overspeed limit is set over that value. When a fault is detected the drive is prevented.

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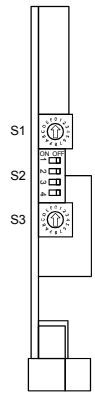
7.1 Standard settings

7.1.1 Settings for sensor bearing

The table below indicate the SSU settings for standard cases. Motors with nominal frequency 100Hz or 120Hz are equipped with bearing sensor. After adjustment, check that parameters V 4.8.1 Overspd Lim 1 and V 4.8.2 Overspd Lim 2 have value between 115% and 125%.

Max Freq S2 is normally set to 120Hz, also when nominal frequency and Max freq S1 are 100Hz. Check that parameters P 2.2.2. Motor Nom Freq and P 2.2.3. Motor Nom Speed have correct values from motor type plate.



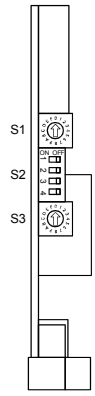
Settings for sensor bearings

Power class	002 – 005	007 – 011	015 - 055
P 2.2.11, Max Freq S2	120	120	120
P 2.2.14 Pulse Number	32	64	80
Rotary switch S1	**1**	**A**	**D**
Switch S2-1	**ON**	**ON**	**ON**
Switch S2-2	**OFF**	**OFF**	**OFF**
Switch S2-3	**OFF**	**OFF**	**OFF**
Switch S2-4	**ON**	**ON**	**ON**
Rotary switch S3	**1**	**A**	**D**

7.1.2 Settings for pulse wheel speed sensor or encoder (24 ppr)

The table below indicate the SSU settings for standard cases. Motors with nominal frequency 50Hz or 60Hz are equipped with pulse wheel speed sensor or encoder. After adjustment, check that parameters V 4.8.1 Overspd Lim 1 and V 4.8.2 Overspd Lim 2 have value between 115% and 125%.

Check that parameters P 2.2.2. Motor Nom Freq and P 2.2.3. Motor Nom Speed have correct values from motor type plate.



Settings for pulse wheel sensor or encoder (24 ppr)

Power class	002 – 055	002 – 055	
P 2.2.11, Max Freq S2	50 / 100	60 / 120	
P 2.2.14 Pulse Number	24	24	
Rotary switch S1	**4**	**7**	
Switch S2-1	**ON**	**ON**	
Switch S2-2	**ON**	**ON**	
Switch S2-3	**OFF**	**OFF**	
Switch S2-4	**ON**	**ON**	
Rotary switch S3	**4**	**7**	

7.2 Functional test run for SSU

☞ Test run must be made without load.

- Disconnect the signal wire coming from the pulse sensor to terminal X1:51.
- Drive with minimum speed. The motion must stop within 1 s.
  fault F63 (stall supervision) is activated

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- Drive with maximum speed, the motion must stop at once
  fault F62 (Speed difference) is activated
- Reconnect the disconnected signal wire to terminal X1:51.
- Set rotary switch S1/S3 value 2 steps smaller
- Drive with maximum speed. The motion must stop after full speed is reached.
  fault F64 (Over speed) is activated
- Set rotary switch S1/S3 back to original value.

7.3 Settings for non-standard cases

Overspeed tripping frequency levels									
Area selection		**300 – 3234 Hz**		**600 – 6467Hz**		**1200 – 12935Hz**		**9600 – 70722Hz**	
S2:2		**ON**		**OFF**		**OFF**		**ON**	
S2:3		**OFF**		**OFF**		**ON**		**ON**	
Range selection Normal	**S2:1**	**OFF**	**ON**	**OFF**	**ON**	**OFF**	**ON**	**OFF**	**ON**
S1/Normal Tripping level selection S2/ESR	**0**	300	1027	600	2055	1200	4110	9600	32878
	1	324	1109	647	2218	1295	4436	10359	35489
	2	350	1195	700	2391	1400	4781	11196	38251
	3	378	1291	756	2582	1511	5163	12092	41304
	4	408	1396	816	2793	1632	5585	13055	44684
	5	441	1506	881	3012	1763	6024	14104	48188
	6	476	1625	951	3251	1902	6502	15217	52013
	7	514	1755	1027	3511	2055	7022	16439	56174
	8	555	1896	1109	3793	2218	7585	17744	60681
	9	599	2048	1198	4096	2395	8192	19163	65536
	A	647	2210	1296	4420	2587	8840	20696	70722
	B	698	2381	1396	4763	2793	9526	22342	--
	C	755	2586	1510	5163	3019	10326	24153	--
	D	815	2793	1630	5585	3259	11171	26075	--
	E	880	3012	1760	6024	3521	12047	28167	--
	F	951	3234	1902	6467	3804	12935	30435	
ESR Range selection	**S2:4**	**OFF**	**ON**	**OFF**	**ON**	**OFF**	**ON**	**OFF**	**ON**

S2:1 together with S1 are used for setting the tripping frequency level at normal speed.
S2:4 together with S3 are used for setting the tripping frequency level at ESR speed.
If ESR is not used, set S2:4 + S3 equal to S2:1 and S1.

Pulse frequency can be calculated from formula = Motor rpm x Pulses per rev / 60

Example

Normal use	A 3000 rpm motor with 32 pulses per revolution has a full speed pulse frequency of 1600 Hz. Suitable maximum overspeed detection level is 1600Hz + 25% = 2000Hz.	On the table the highest value under 2000Hz is 1902Hz. Suitable switch settings are S2-2=OFF and S2-3=OFF S2-1=OFF and S2-4=OFF S1=F and S3=F	Check from V4.8.1 that the detection level is 1902Hz/1600Hz =118,9% of nominal speed.
ESR use	If ESR is applied for 150% of nominal speed, then the full ESR pulse frequency is 1,5 * 1600Hz = 2400Hz. Suitable maximum overspeed detection level is 2400Hz + 25% = 3000Hz.	S2-2=OFF and S2-3=OFF are according to normal speed settings. On the table the highest value under 3000Hz is 2793Hz. Correct switch settings are S2-4=ON and S3=4.	Check from V4.8.2 that the detection level is 2793Hz/2400Hz =116,4% of ESR speed.

Encoder with 600 ppr or over needs both encoder channels connected.

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8 Multicare Function

Two inverter drives can be operated simultaneously in “tandem mode” by utilizing the multicare function. The two drives are connected together using their analog outputs and analog inputs. The analog output of one drive is connected to the analog input of the other drive, and vice versa. Both drives alter the voltage value of their own analog output signal according to run conditions whenever the multicare mode is selected. The table below shows the input (receive) and output (send) values during start, acceleration, stopping and in fault situation. The multicare function is selected with an input parameter (P2.1.5). In case of multicare fault, a dedicated fault code (F70) is issued. If the operation of one drive is interrupted, or the drive faults out (for example upper limit fault), the other drive will stop and show multicare fault (F70). Programmable pushbuttons are used for multicare testing. The multicare function is mainly designed for EP mode (speed correction possible) but it can also be used in MS (multistep) mode for run/stop supervision without speed correction.

Ain1 value	Input function (receive)
0…0.2 V	Single drive selected. Multicare function not used.
0.3…0.7 V	Brake open acknowledged, acceleration not allowed.
0.8…1.0 V	Acceleration allowed.
1…9 V	Speed correction range.
9 V	Acceleration acknowledged.
>9.5 V	Fault acknowledged. Immediate brake stop. F70 fault code issued.

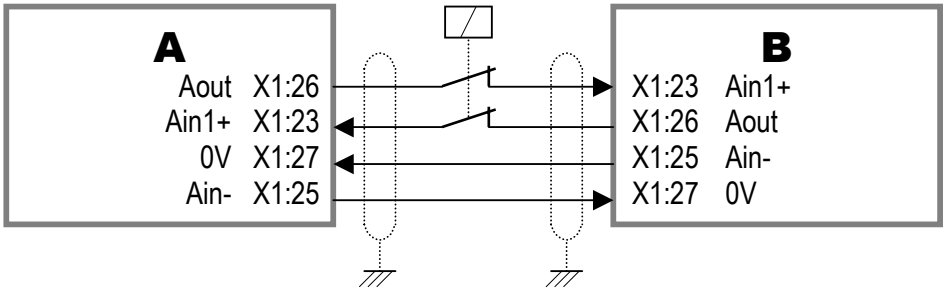
Aout value	Output function (send)
0 V	Direction signals S1 and S2 not active in multicare mode.
0.5 V	Brake open, acceleration not allowed.
1.0 V	Acceleration allowed.
1…9 V	Speed correction range.
9 V	Accelerating.
10 V	Fault. Immediate brake stop.

The multicare function controls and monitors the following situations in multicare mode:

- Both drives start nearly simultaneously (the other drive has 0.5 seconds to respond) and begin to accelerate at the same time, once both brakes are opened.
- Both drives end up running at the same “reference speed” after acceleration or deceleration (EP hold situation) – speed correction is not possible at minimum speed or full speed. The correction takes place whenever the two reference speed values deviate more than 1 %, or about 1 Hz.
- One drive faulting out stops the other and the other drive will issue a multicare fault (F70).
- When only one hoist is selected for operation, the analog signal remains at zero volts and this disables the multicare mode – in case of one hoist drive being faulty (active fault is not cleared when a starting command is issued), the analog signal would remain at 10 volts (fault condition) and both hoists would be inoperational. The solution for allowing the operation of one hoist in single mode, is to open up the analog connection between the two drives with the help of a small relay (see picture below) – this relay must be capable of connecting DC current.

8.1 Connections

The analog output of one drive is connected to the analog input of the other drive, and vice versa (see below). A shielded cable is used to establish the analog signal connection between two drives. Both ends of the cable shield must be grounded using 360-degree grounding whenever possible.



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8.2 Setup

- Verify the connection of analog inputs and outputs and cable shield grounding (both ends).
- Enable the multicare function in both drives - parameter “Analog Input Sel” (P2.1.5=Multicare).
- Verify parameters P2.1.6…P2.1.10 and P2.2.8…P2.2.12 are the same for both drives.
- Activate pushbutton “Test Voltage Max” (B2.1.12.2=”On”) in both drives – this produces a test voltage of 9 V (analog output) for calibrating the maximum value of speed correction.
- Read “Ain Value” (V2.1.12.3) and use this value (about 9 V) for speed correction calibratation – set “Max Value Volt” (P2.1.12.5, both drives) equal to received “Ain Value” – this value is likely the same for both drives.
- Activate pushbutton “Test Voltage Min” (B2.1.12.1=”On”) in both drives – this produces a test voltage of 1 V (analog output) for calibrating the minimum value of speed correction.
- Read “Ain Value” (V2.1.12.3) again and use this value (about 1V) for speed correction calibration – set “Min Value Volt” (V2.1.12.4, both drives) equal to received “Ain Value” – this value, again, is likely the same for both drives.
- Reset both programmable pushbuttons (B2.1.12.1=”Off” and B2.1.12.2=”Off”, both drives).
- Check “Ain Value” (V2.1.12.3) is back at 0 V.

8.3 Test run without load

- Display monitoring parameter “Frequency reference” (V4.9) on both drives.
- In EP mode, accelerate the hoist (up and down) to any speed (between the minimum speed and maximum speed) and verify both drives display the same frequency reference (± 0.25 Hz) when constant speed is reached.
- Lower the frequency value of “Max Freq S1” (P2.2.10) of one drive temporarily about 20 Hz – run in up direction and verify the “faster hoist” will slow down after accelerating. Again, check that both drives display the same frequency reference. Return “Max Freq S1” back to its original value.
- Run both hoists up in tandem mode and stop one hoist by disconnecting the voltage from its upper stop limit terminal (X1:41) – the other hoist must stop and display “Multicare Fault” (F70).
- Reconnect the voltage back to terminal X1:41.
- Repeat the same test with the other hoist.
- Check both hoists operate normally (in tandem mode and single mode) when reaching the slow-down and end stop limit in both directions.

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9 START-UP PROCEDURE

If any problems or malfunctions occur during the start-up, refer to Chapter “Troubleshooting”, to find out the reason. All problems must be solved before continuing.

Warning! High voltages inside device. Wait for at least five minutes after the supply voltage has been switched off before service actions. Display in operating condition (lights on) indicates a dangerous voltage on the DC-bus. When display turns off, the DC-bus voltage is about 100V. Note also that there is a dangerous voltage in the braking resistor always when the DC-bus is charged.

Do not connect any voltage to the output terminals (U, V, W). Otherwise, the inverter will be damaged.

The overload protection protects both the supply and the motor cables. The fuses of the supply provide short circuit protection.

9.1 Visual checks

- Check condition of cubicles.
- Check that serial number of the drive is the same as in delivery documents.
- Check the switch settings on SSU (see Chapter “Speed Supervision Settings”)
- If necessary, open the control box cover and adjust the SSU settings.
- Check the cabling to braking resistor.
- Check the cabling to motor, brake, thermistors and speed sensor.
- Check motor type.
- Check the wire terminations in the motor connection box
- Check connections for motor, thermistors, brake wear and speed sensor circuits.
- Disconnect motor (U, V, W) and brake cables to prevent damage of inverter. Measure insulation resistance of brake coil and motor windings (each phase to ground).
- Re-connect motor and brake cables.
- Check braking resistor(s).
- Terminals X1:21-27 and X1:51-57 are for electronics level signals.
- Normally only shielded wires are connected to these terminals. Check that no control or line voltage level wires are connected there.

9.2 Checks before the first test run

- Check power supply voltage (nominal voltage +/- 10%).
- Check control voltage (nominal voltage +/- 10%).
- Make sure that run commands are off (pushbuttons / controller (master switch) at zero position).
- Turn on power from main switch and control voltage switch.
- Within about 1 second the control panel should display "AC on", and then in about 1 second the display changes to motor output frequency "0.00" and green READY status indicator turns on.
- In a fault situation the red FAULT status indicator blinks and the display shows a fault code instead of frequency.
- Check that green RUN status indicator is off.
- Check that external connections and selected control method are according to application.
- Parameters are properly set after factory tests and no adjustments are needed except for the parameters that depend on application. Write down on the parameter list all the values that have been changed and at the end save parameters to User parameters, see chapter “User parameters”.

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9.3 Test run without load

- Make sure that movement will not cause any danger to the environment or to the crane itself. Avoid driving close to the limit areas.
- Check limit switches manually if possible.
- Check the run commands on display panel and correct the drum rotating direction. The arrow rotates clockwise if S1 is applied and counter-clockwise if S2 is applied.
- Check the function of the speed sensor, see chapter “Speed sensors”
- Check the function of the speed supervision circuit. See chapter "Functional test drive for SSU".
- Drive direction S1 at minimum speed for 5 to 10 seconds. Accelerate to full speed. Run 5 to 10 seconds. Stop. Repeat the same in direction S2. Check the frequency display to make sure that the frequency changes through the whole operational frequency range from minimum to nominal speed.
- Check motor operation (acceleration, deceleration and braking): accelerate to full speed direction S1, change to full speed direction S2 and full speed direction S1 again and stop.
- Check limit switch functions: drive direction S1 slowly and check the limit switch operations. Re-check using full speed. Repeat the same check for direction S2.

9.3.1 Functional test run for SSU

☞ Note! Test run for SSU must be made without load.

- Disconnect the signal wire coming from the pulse sensor to terminal X1:51. All the SSU faults will be reseted automatically after one second when the pulses from the pulse sensor are missing
- Drive with minimum speed. The motion must stop within set time.
- fault F63 (stall supervision) is activated
- Drive with maximum speed, the motion must stop at once
- fault F62 (Speed difference) is activated
- Reconnect the disconnected signal wire to terminal X1:51.
- Set rotary switch S1/S3 value 2 steps smaller
- Drive with maximum speed. The motion must stop after full speed is reached.
- fault F64 (Over speed) is activated
- Set rotary switch S1/S3 back to original value.

9.4 Test run with load

- Note, three loads are required:
  Nominal load (100%) for normal operation.
  Limited load for ESR (optional).
  An adequate extra load for dynamic overload testing and to test the ESR load limit.
- Make sure that movement will not cause any danger to the environment or to the crane itself.
- If the optional extended speed range (ESR) is used, check that the load limit is correctly set and hoisting with bigger loads is prevented.
- Drive in both directions at minimum and maximum speeds.
- If the fan tube resistor unit is included, check that fan(s) starts to blow when driving down with nominal load and continues to blow for about 4-5 minutes after stopping

9.5 Test run with overload

If an overload test has to be performed during crane commissioning, minimum frequencies should be raised for duration of the commissioning to 20Hz. Minimum frequencies can be changed with parameters P2.2.8 and 2.2.9. After testing, minimum frequencies should be changed back to their original values.

9.6 After the test run

- Record all parameter value changes in the parameter list.
- Make sure all remarks and setting values are recorded.
- It is recommended to store the parameter settings in file User parameters, see chapter “User parameters”.

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10TROUBLESHOOTING

Warning! High voltages inside Frequency converter. Wait for at least five minutes after the supply voltage has been switched off before service actions. The display in the operating condition (lights on) indicates a dangerous voltage on the DC-bus. When display turns off, the DC-bus voltage is approximately 100V. Note also that there is always a dangerous voltage in the braking resistor when the DC-bus is charged.

10.1 Field repair actions

The purpose of troubleshooting and field repair actions is primarily to determine whether the drive or external devices in fact cause the problems. After that, the next step is to detect the possibly damaged components inside the drive. If any damage inside the drive is caused by the environment (motor failure, brake failure, power supply problems etc.) it is very important to repair/change faulty items to prevent reoccurring problems.

The best way to repair a faulty inverter is to replace it with a new one. If the fault can be located, it is also possible to replace some of the components. When replacing an inverter or a Control unit with a new one, the parameter list of the existing drive is needed so that the parameter settings can be copied to the new one.

If parameters have been copied to the keypad before damage, it may be used for uploading the parameters to the spare part inverter (requires same software versions).

10.2 Typical functional problems

- Inverter does not start when mains is connected.
  Check mains voltage between terminal L1, L2 and L3

- Indicator "Ready" is on and Indicator "Fault" is off, but motor does not run.
  Check control mode selection
  Check voltage at run command terminals X1:8 and X1:9
  Check state of digital inputs from parameter V4.7.12

- Motor runs poorly
  Check that load is not over nominal
  Check that all cables are connected correctly and the junctions are reliable
  Check that all motor dependant parameters are correct
  Check the voltage of the slowdown limit switch input
  Check state of digital inputs from parameter V4.7.13
  Check that motor's brake opens completely
  Check that minimum speed parameters do not have too small values
  Check u/f-curve tuning
  If the main girder is new, it might be necessary to drive trolley several times with no load from end to end, before beginning of u/f-curve tuning

- Some parameters are not accessible or changing is not possible
  Check password that password has value 2156
  Check that parameter value is inside the limits
  Parameter value can not be changed in RUN state
  Parameter value change must be confirmed with "Enter" button

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10.3 Inverter fault codes

If any of the following failures is found, the inverter displays the fault code and closes the mechanical brake causing the movement to stop. If several faults occur one after another, the latest one is displayed, the others are stored to fault history page.

When inverter fault supervision trips, the FAULT indicator turns on and the blinking fault code “F xx“ (xx = fault number) appears on the display.

The drive includes an automatic fault reset operation; the fault code stays on the display until the fault is removed and the controller released back to 0-position. Some of the fault codes require to switch the power off before run is possible.

The faults are stored to the fault history, from there they can be seen if necessary. The fault history can store last 30 fault codes. Following exceptions exist when storing faults to the fault history

- not stored faults: F6, F70
- repeated faults are stored only once: F50, F51, F55, F60, F66, F71, F72

Fault code	Fault	Possible cause	Checking	A	B
F 1	**Overcurrent**	Inverter has measured too high current (over 4*In) in the motor output: sudden heavy load increase short circuit in the motor or cable not suitable motor wrong motor parameters	Reset: switch power off and restart after the lamps of display are off. Check: brake operation motor type and power rating parameters motor cable connection motor insulation motor loading		X
F 2	**Overvoltage**	DC-bus voltage has exceeded 135% maximum level, 911Vdc supply voltage raised >1.35 x Un (high overvoltage spikes at mains or not sinusoidal wave form) Deceleration time is too short	Reset has an additional 5s time delay. Check: Adjust the deceleration time longer measure main supply voltage level and wave form while not driving motor insulation motor cable insulation (phase-ground, phase-phase) braking resistor cable braking resistor type and resistance braking chopper operation		X
F 3	**Earth fault**	Current measurement has sensed unbalance in motor phase currents. Supervision level is 5% of inverter nominal current not symmetric load insulation failure in the motor or the cables	Reset has an additional 5s time delay. Check: motor insulation motor cable insulation (phase-ground, phase-phase)		X
F 5	**Charging switch**	Charging switch is open when START command becomes active interference fault component failure	Check: control unit and power unit connections charging resistors If the fault comes again, change the control unit.		X
F 6	**External Stop**	Either the ES or RDY-signal has been tripped during run Fault is not stored into fault history.	Check: ES and RDY external connections	X	
F 7	**Saturation trip**	Very high overload or defective component	Reset: switch power off and restart after the lamps of display are off. Check: motor and motor cable insulation		X

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			measure main circuit diodes and IGBT transistors If the fault comes again, change the power unit.		
F 8	**System fault**	System fault due to component failure or faulty operation.	Reset: switch power off and restart after the lamps of keypad are off. Check: read fault extension code and contact authorized service If the fault comes again, change the D2V.		X
F 9	**Undervoltage**	DC-bus voltage has dropped below 333Vdc mains supply voltage interrupted inverter fault can also cause an undervoltage trip external fault during run may cause an undervoltage trip	In case of temporary supply voltage break, reset the fault and start again. Check mains input. If mains supply is correct, an internal failure has occurred. Contact authorized service.	X	
F 10	**Input line supervision**	One input line phase is missing.	Check: supply voltage mains connection.	X	
F 11	**Output phase supervision**	Current supervision has sensed that at least one of the motor phases has no current	Check: motor cable connections measure motor phase currents and compare to display value		X
F 12	**Braking chopper supervision**	Braking chopper or braking resistor circuit has failed. Test pulse measures transistor collector voltage. Fault appears if braking resistor is broken braking chopper is broken braking resistor is not installed	Reset: switch power off and restart after the lamps of display are off. Check: braking resistor and insulation resistance measure braking transistor IGBT and free wheeling diodes If resistor is OK, then the chopper is broken Contact authorized service		X
F 13	**Inverter undertemperature**	Temperature of heat sink is below acceptable operating level (-10°C /14°F)	Check ambient temperature cubicle heating	X	
F 14	**Inverter overtemperature**	Temperature of heat sink is over acceptable operating level +90°C (194°F). Overtemperature warning is issued when the heat sink temperature exceeds +85°C (185°F)	Check: ambient temperature inverter cooling fan operation cooling air flow through heat sink heat sink is not dusty	X	
F 22 **F 23**	**EEPROM checksum fault**	Parameter save error interference fault component failure (control unit)	After power off the inverter will automatically reset parameter settings. The drive does not work properly nor enable driving after this fault. Check: all parameter settings. +24V voltage output loading If the fault comes again, contact authorized service center.		X
F 24	**Changed data warning**	Changes may have occurred in the different counter data due to mains interruption	No special actions required. Take a critical attitude to the counter data.		X
F 25	**Microprocessor watchdog-fault**	interference fault component failure (control unit)	Reset: switch power off and restart after the lamps of display are off. If the fault comes again, contact service.		X
F 26	**Power Unit Fault**				X
F 31	**IGBT temperature**	Too high temperature in IGBT. A hardware temperature measurement has tripped.	Reset: switch power off and restart after the lamps of keypad are off. Check: motor loading brake operation inverter heatsink inverter cooling fan operation environment temperature		X
F 32	**Fan cooling fault**	Cooling fan of the frequency converter do not work, when ON command has been given	If the fault comes again, contact authorized service.		X
F 35	**Application fault**	Run-time exception in the application program	Contact authorized service.		X
F 36	**Control Unit**	Faulty Control Unit.	Contact authorized service.		X
F 37	**Device changed**	Option board changed.	Reset the fault	X	
F 38	**Device added**	Option board added.	Reset the fault	X	
F 39	**Device removed**	Option board removed.	Reset the fault	X	
F 40	**Device unknown**	Unknown option board or drive.	Check board and drive type.		X
F 41	**IGBT tempetature**	Too high temperature in IGBT transistors. long duration overload lowered cooling	Reset: switch power off and restart after the lamps of keypad are off. Check: motor parameters		X

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		high environment temperature	u/f curve settings motor loading brake operation inverter heatsink inverter cooling fan operation environment temperature		
F43	**Encoder failure**	Encoder failure. Subcodes: S1 = EA+/- is missing S2 = EB+/- is missing S3 = Both EA+/- and EB+/- are missing S4 = EA+/- and EB+/- are crossconnected S5 = SSU-board is missing or system load is too high	Check: Encoder cabling Brake opening Encoder mechanical assembly Encoder type and pulse number		X
F44	**Device changed**	Option board or control unit has been changed to different type or different power rating	Reset the fault. Option board parameters or all parameters are set up to default values.		X
F45	**Device added**	Option board of different type or drive of different power rating added.	Reset the fault. Option board parameters or all parameters are set up to default values.		X
F50	**Reference value fault**	Analog input signal is out of selected range 1-9V or 2-10V Control cable is broken Signal source has failed	Check: Reference cable Reference source		X
F 51	**Stop limit**	Stop limit has tripped	Reset: keep controller at zero >300ms. Ensure that fault disappears after leaving the stop limit.	X	
F 55	**Board Fault**	Some of following board is missing: A = Basic I/O board B = Thermistor board D = Expansion board	Reset: switch power off and restart after the lamps of keypad are off. Check: board slots A, B and D drive selection control mode		X
F 56	**Generator side current limit**	Too short deceleration time generator side current limit	Reset has an additional 5 s time delay. Check: deceleration time		X
F 57	**Thermistor fault**	Thermistor input in relay / thermistor board has detected motor overtemperature. Fault appears when thermistor input has been open over 1s.	Check: motor cooling and loading thermistor connection. If expansion board thermistor input is not used, it should be shorted motor parameters the brake operation	X	
F 60	**Parameter fault**	Inverter has lost parameters. Drive selection parameter has changed to 0 / none.	Download parameters from keypad		X

F 61	Overspeed Fault	SSU has tripped to Overspeed (hardware supervision). Motor speed has increased above overspeed detection level.	Reset when 1s without pulses from pulse sensor/encoder to SSU and controller at zero position. Check: function and cabling maximum frequency setting parameters SSU settings		X
F 62	Speed Difference Fault	SSU has tripped to Speed Difference	Reset when 1s without pulses from pulse sensor/encoder to SSU and controller at zero position. Check: pulse sensor/encoder function and cabling pulse sensor/encoder pulse number speed difference supervision settings		X
F 63	Stall Supervision Fault	SSU has tripped to Stall.	Reset when 1s without pulses from pulse sensor/encoder to SSU and controller at zero position. Check: brake operation pulse sensor/encoder function and cabling stall supervision settings		X
F 64	SSU Relay Test Fault	Relay in SSU board is damaged or SSU relay is bypassed	Reset: switch power off and restart after the lamps of keypad are off. Check: ES and RDY external connections OK input operation change SSU board		X

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F 65	SSU Watchdog	SSU internal fault interference fault between SSU board and control board component failure (control board or SSU board)	Reset: switch power off and restart after the lamps of display are off. Check: SSU status (System menu / System info / Expander boards / C: SSU / status) SSU LED's If the fault comes again, contact service		X
F 66	SSU Overspeed Limit	SSU overspeed limit has been set over 140% of maximum frequency	Check: set SSU overspeed limit under 140% of maximum frequency motor type plate parameters maximum frequency parameters		X
F 70	Multicare Fault	Other inverter has tripped to fault or brake of other inverter has not been opened. Fault is not stored into fault history.	Check other hoisting inverter: fault history brake operation		X
F 71	Brake Control Fault	Load information from hoist control unit is out of operation window	Check Ain2 wiring settings of load measuring device		X
F 73	Both Dir Active	Both direction signals are active at same time >500ms	Check controller operation wiring of direction signals		X

A = Can be done by the user
B = Can be done only by manufacturer authorized personnel

10.3.1 Fault time data record

When a fault occurs, the fault number is displayed. By pushing the menu button right here you will enter the Fault time data record menu, indicated by T.1-T.13.

In this menu, some selected important data valid at the time of the fault are recorded. The data available are:

T.1	Counted operation days	d
T.2	Counted operation hours	hh:mm:ss
T.3	Output frequency	Hz
T.4	Motor current	A
T.5	Motor voltage	V
T.6	Motor power	%
T.7	Motor torque	%
T.8	DC voltage	V
T.9	Unit temperature	°C
T.10	Ready Run	0=Not Ready 1=Ready 0=Not Running 1=Run
T.11	Direction Fault	0=Off 1=On 0=No 1=Yes
T.12	Warning At reference	0=No 1=Yes 0=No 1=Yes
T.13	0-speed	0=Not Zero Speed 1=Zero Speed

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10.3.2 Fault Counter

V4.5.1	Fault Counter	Fault counter value. Counter value is shown in format Fault counter value. Fault number. E.g. 12.01 means that there has been 12 pieces overcurrent faults.
		When counter value is blinking, then you can monitor fault counter values by pressing up and down arrows.
	xx.01 Overcurrent fault counter xx.02 Overvoltage fault counter xx.03 Earth fault counter xx.07 Saturation trip fault counter xx.09 Undervoltage fault counter xx.10 Input line supervision fault counter xx.11 Output phase supervision fault counter xx.12 Braking chopper supervision fault counter xx.13 Inverter undertemperature fault counter xx.14 Inverter overtemperature fault counter xx.25 Microprocessor watchdog-fault counter xx.41 IGBT temperature fault counter xx.53 Profibus communication error fault counter xx.56 Generator side current limit fault counter xx.57 Thermistor fault counter xx.61 Overspeed fault counter xx.62 Speed difference fault counter xx.63 Stall supervision fault counter xx.99 Sum counter of following faults: F4, F5, F8, F22, F23, F24, F26, F32, F33, F34, F35, F36, F37, F38, F39, F40, F48, F50, F54, F55, F60, F64, F65, F71, F72	
V4.5.2	Total Faults	Total number of all faults.

10.4 Inverter Alarm codes

Alarm is a sign of an unusual operating condition. Alarm remains in the display for about 30 seconds.

Alarm code	Possible cause	Checking
A 16 Motor overtemperature	Mathematical motor temperature model has detected motor overheating. Motor is overloaded.	Check: motor load if no overload exists, then check motor temperature model parameters
A 50 Reference value alarm	Analog input signal is out of selected range 1-9V or 2-10V control cable is broken signal source has failed	Check: reference cable reference source
A 80 Multistep sequence alarm	Controller does not operate accurately	Check: controller
A 82 Overweight alarm	Motor load is over adjusted value	Check: Overweight limit value
A 83 Slack cable alarm	Motor load is under adjusted value	Check: Slack cable limit value

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11TROUBLESHOOTING TABLE

If inverter doesn't work, but any fault doesn't found write down the following information before contacting to the supplier.

GENERAL INFORMATION	
WORK NUMBER	
CUSTOMER REFERENCE	
DATE PUT IN OPERATION	
DATE OF FAILURE	
SHORT DESCRIPTION OF FAILURE, ERROR CODE	

INVERTER INFORMATION			
TYPE CODE		ACCELERATION TIME	S
SERIALNUMBER		DECELERATION TIME	S
CONTROL METHOD		MIN FREQ	Hz
EP2		MAX FREQ	Hz
EP3			
MS			

MOTOR INFORMATION			
TYPE CODE		NOMINAL VOLTAGE	S
SERIALNUMBER		NOMINAL CURRENT	S
U/F-CURVE (Travelling inverter)		NOMINAL FREQUENCY	
Zero freq volt	%	NOMINAL SPEED	
U/f Mid volt	%	POWER FACTOR	
U/f Mid freq	Hz	PULSE SENSOR PULSE / REV (Hoisting inverter)	

MEASURED VALUES							
INVERTER				MOTOR			
VOLTAGE PHASE-TO-PHASE	L1-L2 VAC	L1-L3 VAC	L2-L3 VAC	NOMINAL CURRENT	U-V Ω	V-W Ω	W-U Ω
VOLTAGE PHASE-TO-GROUND	L1 VAC	L2 VAC	L3 VAC				
MEASURED CONTROL VOLTAGE	V						

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12SERVICE

The drive does not require regular maintenance. However the following actions are recommended:

- Check fault history
  Find out reasons of possible faults
  Clear the fault history
- Clean the heat sink
  Prevent the dust to spread inside cubicles
  Lock the fans before blowing compressed air
- Check that there are no abnormal noises coming from the cooling fan
- Tighten all screws and connectors
- Clean dust from PC-boards
- Check the speed supervision circuit (only in hoisting inverter)
  See chapter "Functional test run for SSU"

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13SPARE PARTS LIST FOR HOISTING INVERTER

☞ Inverter D2V includes boards for slots A, B and D, but does not include SSU, speed supervision unit for slot C.

POS	DESCRIPTION	NAME	ID	REMARKS	002	003	004	005	007	011	015	018	022	030	037	045	055
INVERTER																	
A1	Inverter	D2V002NF1N04	52335533	EMC level N/S	1												
		D2V002NF1004	52335558	EMC level 0	1												
		D2V003NF1N04	52335534	EMC level N/S		1											
		D2V003NF1004	52335557	EMC level 0		1											
		D2V004NF1N04	52335535	EMC level N/S			1										
		D2V004NF1004	52335556	EMC level 0			1										
		D2V005NF1N04	52335536	EMC level N/S				1									
		D2V005NF1004	52335555	EMC level 0				1									
		D2V007NF1N04	52335537	EMC level N/S					1								
		D2V007NF1004	52335554	EMC level 0					1								
		D2V011NF1N04	52335538	EMC level N/S						1							
		D2V011NF1004	52335553	EMC level 0						1							
		D2V015NF1N04	52335539	EMC level N/S							1						
		D2V015NF1004	52335552	EMC level 0							1						
		D2V018NF1N04	52335540	EMC level N/S								1					
		D2V018NF1004	52335551	EMC level 0								1					
		D2V022NF1N04	52335541	EMC level N/S									1				
		D2V022NF1004	52335550	EMC level 0									1				
		D2V030NF1N04	52335542	EMC level N/S										1			
		D2V030NF1004	52335549	EMC level 0										1			
		D2V037NF1N04	52335543	EMC level N/S											1		
		D2V037NF1004	52335548	EMC level 0											1		
		D2V045NF1N04	52335544	EMC level N/S												1	
		D2V045NF1004	52335547	EMC level 0												1	
		D2V055NF1N04	52335545	EMC level N/S													1
		D2V055NF1004	52335546	EMC level 0													1
BOARDS INCLUDED IN INVERTER D2V																	
	Basic I/O-board	NXOPTA6L	52335566	Slot A	1	1	1	1	1	1	1	1	1	1	1	1	1
	Relay / Thermistor board	NXOPTA3L	52335565	Slot B	1	1	1	1	1	1	1	1	1	1	1	1	1
	I/O Extension board	NXOPTB9L	52335564	Slot D	1	1	1	1	1	1	1	1	1	1	1	1	1
SPEED SUPERVISION UNIT, SSU (not included in inverter D2V)																	
	Speed supervision unit	SSUL	52335567	Slot C	1	1	1	1	1	1	1	1	1	1	1	1	1
BRAKE SUPPLY CIRCUIT BREAKER																	
F7	Protective switch	GV2-ME08	52297213						1	1	1	1	1	1	1	1	1
	Auxliary contact	GV2-AN20	52275270						1	1	1	1	1	1	1	1	1
F71	Protective switch	GV2-ME08	52297213														1
	Auxliary contact	GV2-AN20	52275270														1
BRAKE CONTACTOR																	
K7	Contactor	LC1-D09D7	52303564	42VAC	1	1	1	1	1	1	1	1	1	1	1	1	1
		C01E7	52296542	48VAC	1	1	1	1	1	1	1	1	1	1	1	1	1
		C01F7	52296548	115VAC	1	1	1	1	1	1	1	1	1	1	1	1	1

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		LC1-D09P7	52296643	230VAC	1	1	1	1	1	1	1	1	1	1	1	1	1
At K7	RC-filter	LA4-DA1E	52275256	42/48VAC	1	1	1	1	1	1	1	1	1	1	1	1	1
		LA4-DA1U	52275257	115/230VAC	1	1	1	1	1	1	1	1	1	1	1	1	1
BRAKE CONTROL UNIT (DC-BRAKE)																	
G1	Brake control unit	REC12	60010145		1	1	1	1	1	1							
		ESD141	60003098								1	1	1	1	1	1	1
SECOND BRAKE CONTACTOR																	
K71	Contactor	LC1-D09D7	52303564	42VAC													1
		C01E7	52296542	48VAC													1
		C01F7	52296548	115VAC													1
		LC1-D09P7	52296643	230VAC													1
	RC-filter	LA4-DA1E	52275256	42/48VAC													1
		LA4-DA1U	52275257	115/230VAC													1
	Auxliary contact	LAD-8N20	52297562														1
		LAD-N04	52297548														1
COMPONENTS FOR EMC LEVEL (N)																	
CM1	Y-capacitor	KC-307-00	52298693	42VAC	1	1	1	1	1	1	1	1	1	1	1	1	1
Z1	Ferrite	RU2100-30-7	52299351	Emission level N	1	1	1	1	1	1							
Z2		RH175285107	52297604		1	1	1	1	1	1							
Z3		RH175285107	52297604		1	1	1	1	1	1							
Z1		EF32010	52299352								2	2	2				
Z2		W74270096	52299353								1	1	1				
Z3		W7427015	52299354								2	2	2				
Z1		EF32010	52299352											2	2	2	
Z2		W7427015	52299354											1	1	1	
Z3		W742701111	52300355											7	7	7	
Z2		W7427015	52299354														3
Z3		W7427015	52299354														4

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14.1.2 Power classes 015F - 055F

No	Name	Description, signal level
	PE	
91	L11	Auxiliary power supply, phase 1
92	L12	Auxiliary power supply, phase 2
93	L13	Auxiliary power supply, phase 3

No	Name	Description, signal level	No	Name	Description, signal level
1	BL1	AC brake supply, phase 1	31	BD1	DC brake supply 1
2	BL2	AC brake supply, phase 2	32	BD2	DC brake supply 2
3	BL3	AC brake supply, phase 3	33	T1	Thermistor input
4	T12	Reserved for thermistors connections	34	T2	Thermistor input
5	OLE	External control voltage, 42/48/115/230Vac	35	ONE	Neutral of external control voltage OLE
6	OLE	External control voltage, 42/48/115/230Vac	36	ONE	Neutral of external control voltage OLE
7	RDY	Stop with brake	37	ES	External Stop
8	S1	Direction 1 run command	38	DID1	Free input
9	S2	Direction 2 run command	39	DID2 (S11)	Slowdown signal, direction 1
10	DIA3	Accelerate / speed 2	40	DID3 (S21)	Slowdown signal, direction 2
11	DIA4	Not used / hold / speed 3	41	DID4 (S12)	Stop limit signal, direction 1
12	DIA5	Not used / speed 4	42	DID5 (S22)	Stop limit signal, direction 2
13			43		
14			44		
15	K7-A1	Coil of brake contactor K7	45	ROB1-21	Not used
16	ROB1-22	Not used	46	ROB1-23	Not used
17	ROD1-28	Free NO-contact of relay ROD1	47	ROD1-29	Free NO-contact of relay ROD1
18	K7-153	Free NO-contact of K7	48	K7-154	Free NO-contact of K7
19	K7-163	Free NO-contact of K7	49	K7-164	Free NO-contact of K1
20	K71-13	Free NO-contact of K71	50	K71-14	Free NO-contact of K71
		PE			
21	PUR	Not used	51	EA+	Encoder channel A+
22	+15V	Not used	52	EA-	Encoder channel A-
23	AIN1+	Multicare speed reference input, 0...+10V	53	EB+	Encoder channel B+
24	AIN2+	Not used	54	EB-	Encoder channel B-
25	AIN-	Common for analog inputs	55	+24V	+24V output for encoder
26	AOUT	Multicare speed reference output 0...+10V	56	0V	Common for encoder supply
27	0V	Common for analog output	57	+24V	External supply for Control module
		PE			

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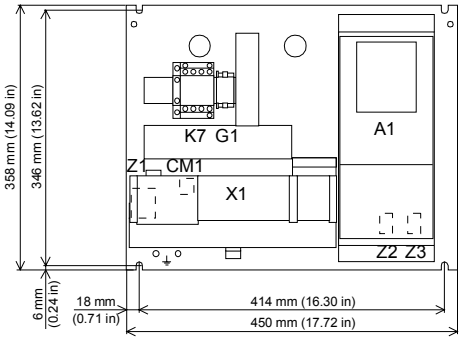
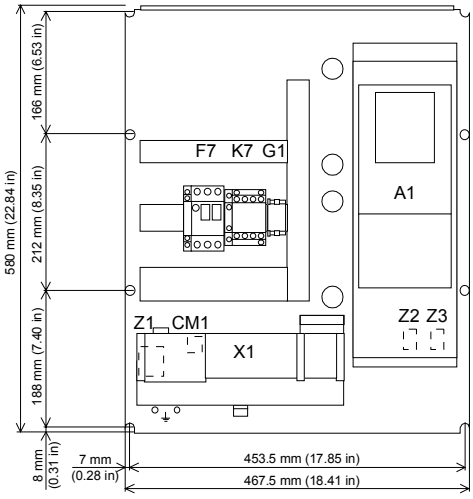
14.2 Layouts, dimensions and weights

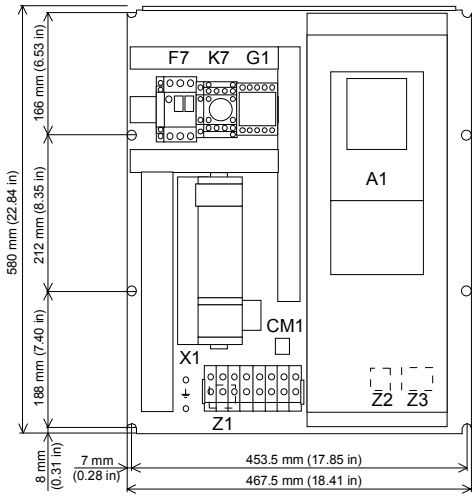
002F - 005F
Weight 12 kg (27 lbs)



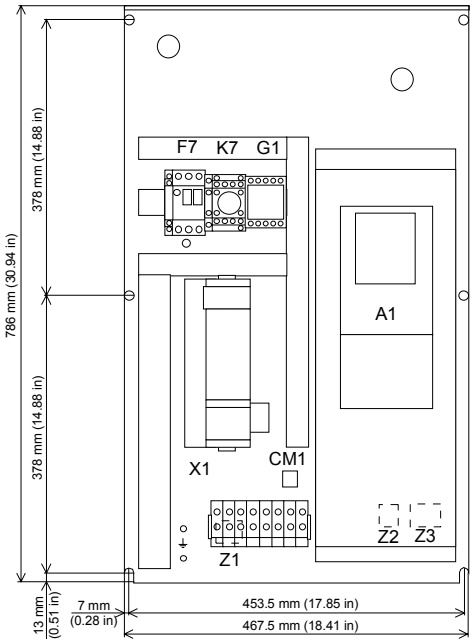
007F - 011F
Weight 19 kg (42 lbs)



015F
Weight 29 kg (64 lbs)



018F – 022F
Weight 31 kg (68 lbs)



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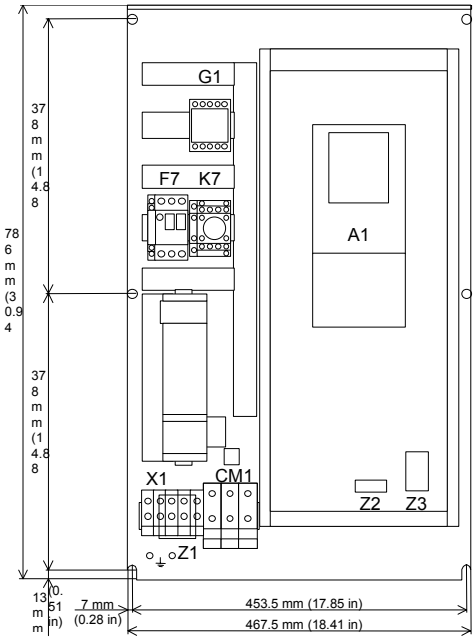
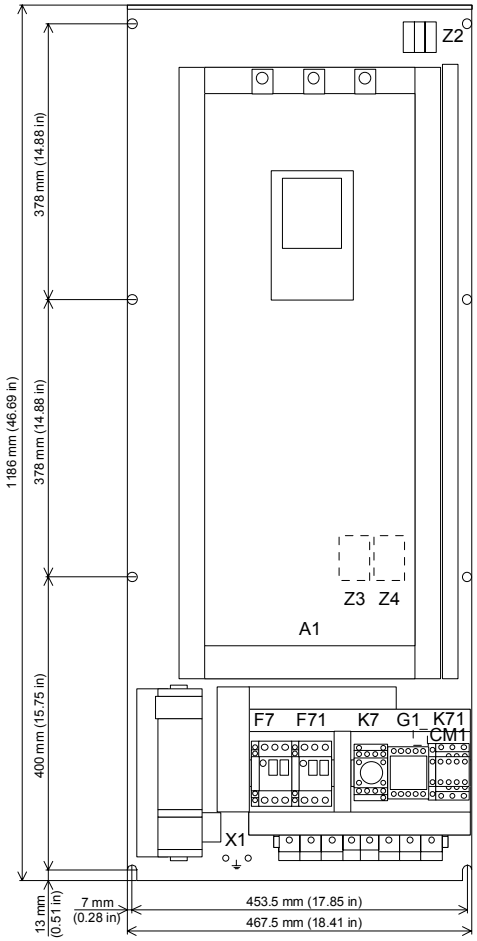
030F - 045F
Weight 47 kg (102 lbs)



055F
Weight 80 kg (176 lbs)



14.3 Circuit diagrams

- 002F – 005F
- 007F – 011F
- 015F – 045F
- 055F

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14.3.1 Internal wirings

PE	A	B	C	D	Other single wires	Screened cables
002F – 011F 2.5 mm² AWG 14	002F – 011F 2.5 mm² AWG 14	002F – 018F 2.5 mm² AWG 14	002F – 055F 2.5 mm² AWG 14	002F – 055F 1.5 mm² AWG 16	002F – 055F 0.75 mm² AWG 20	002F – 055F 8 x 0.5 mm² 8 x AWG 20
015F – 018F 6 mm² AWG 10	015F – 018F 6 mm² AWG 10					
022F – 037F 10 mm² AWG 8	022F 10 mm² AWG 8	022F 6 mm² AWG 10				
	030F – 037F 16 mm² AWG 6	030F – 045F 10 mm² AWG 8				
045F 16 mm² AWG 6	045F 25 mm² AWG 4					
055F – 075F 25 mm² AWG 4	055F 35 mm² AWG 2	055F 16 mm² AWG 6				

14.3.2 Wiring colours

Single wires		Screened cable board A		Screened cable board C	
PE	Green-Yellow	PUR	Grey	EA+	Grey
A	Black	+15V	Pink	EA-	Pink
B	Black	AIN1+	Green	EB+	Green
ONE	White	AIN2+	Yellow	EB-	Yellow
Others	Red	AIN-	Blue	+24V	Brown
		AOUT2	Red	0V	White
		0V	White		
		+24V	Brown		

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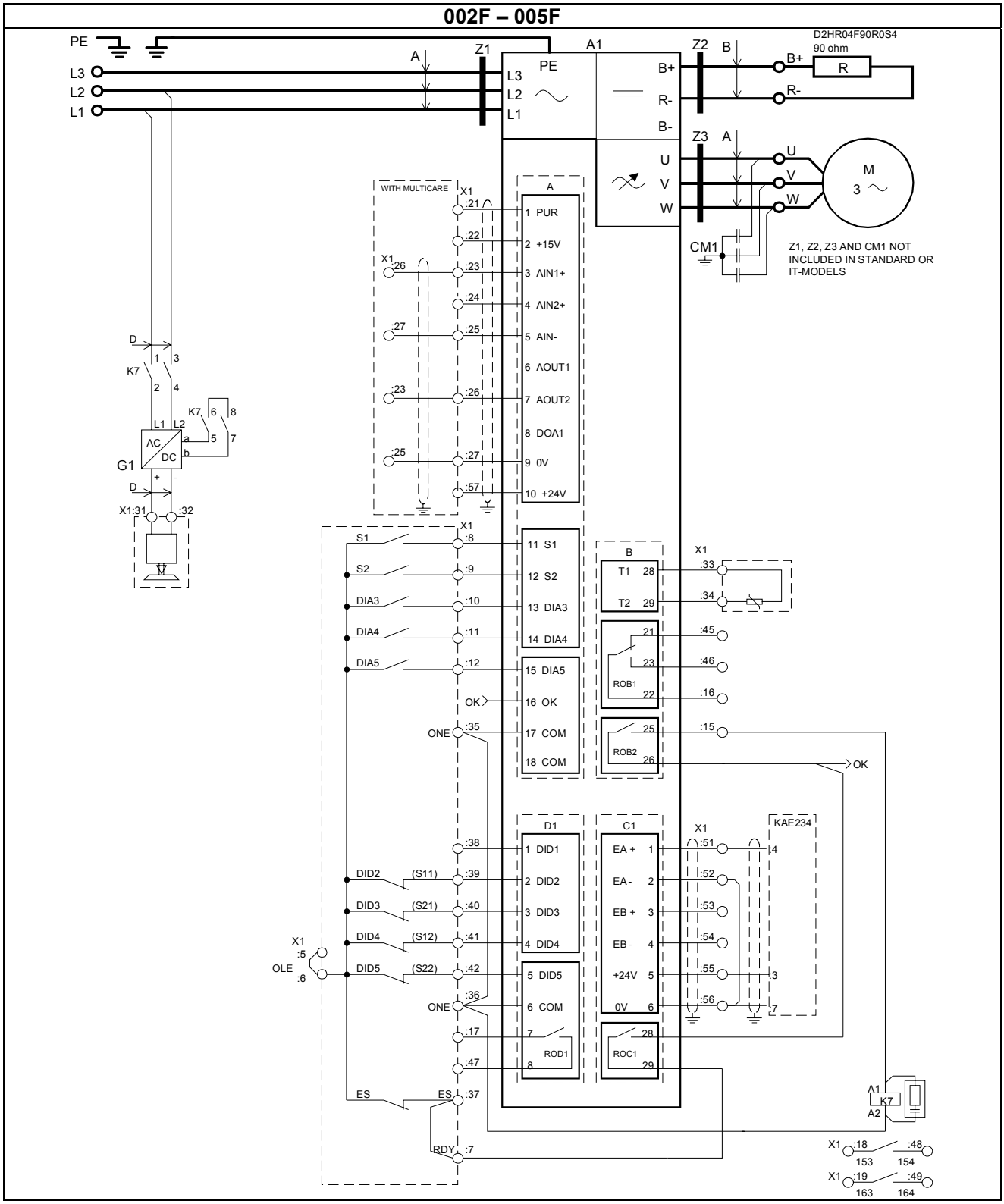
002F – 005F



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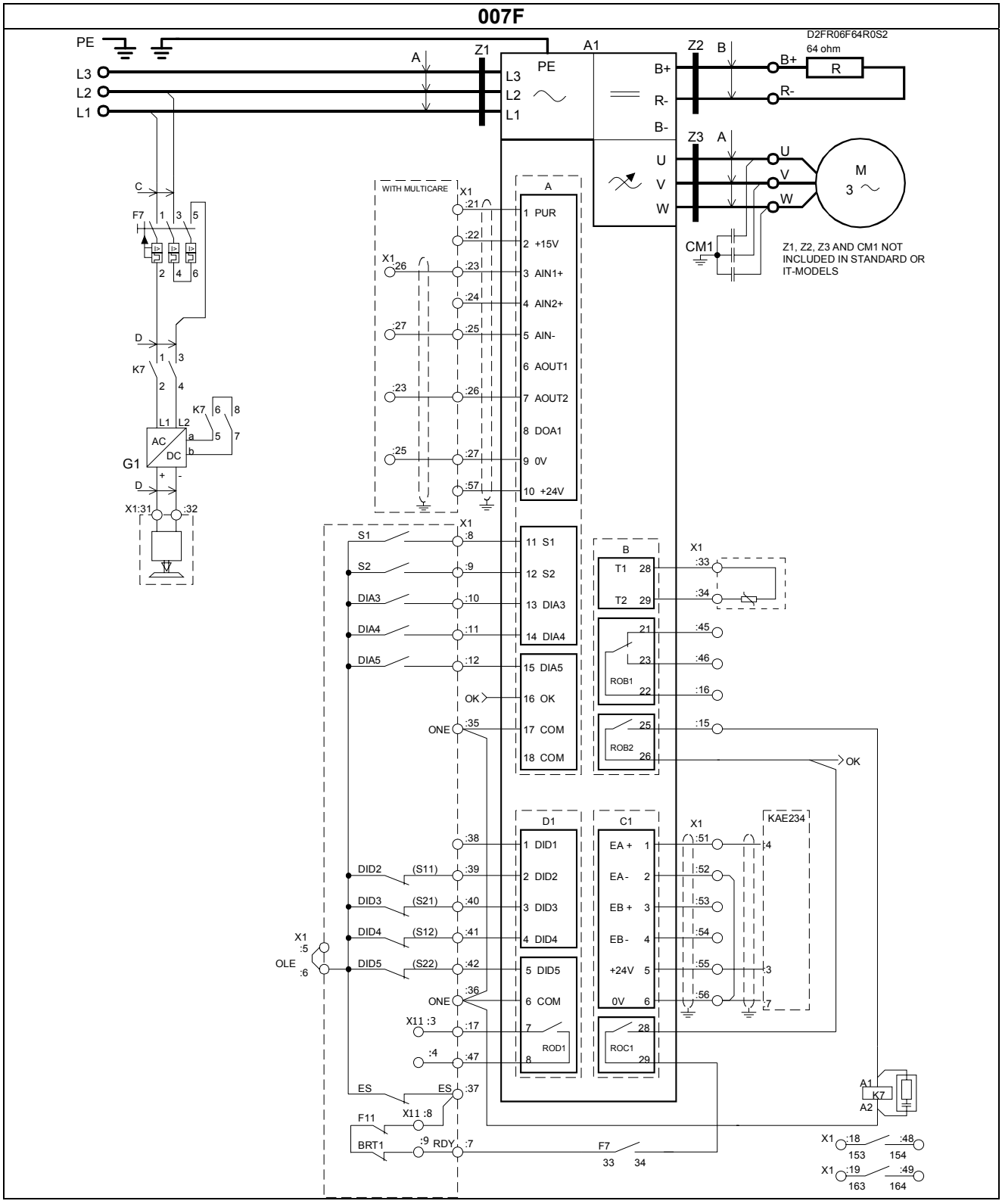
007F



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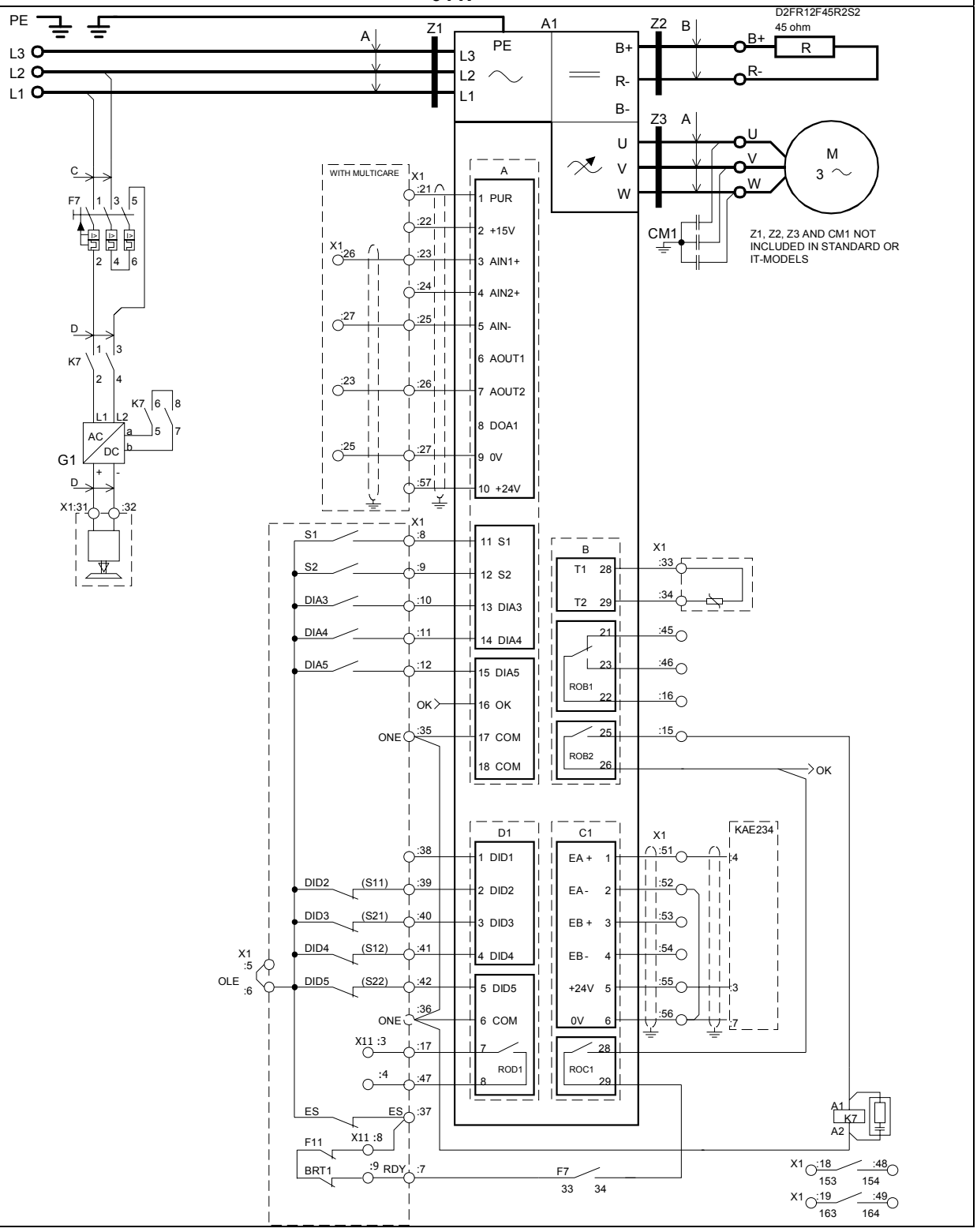
011F



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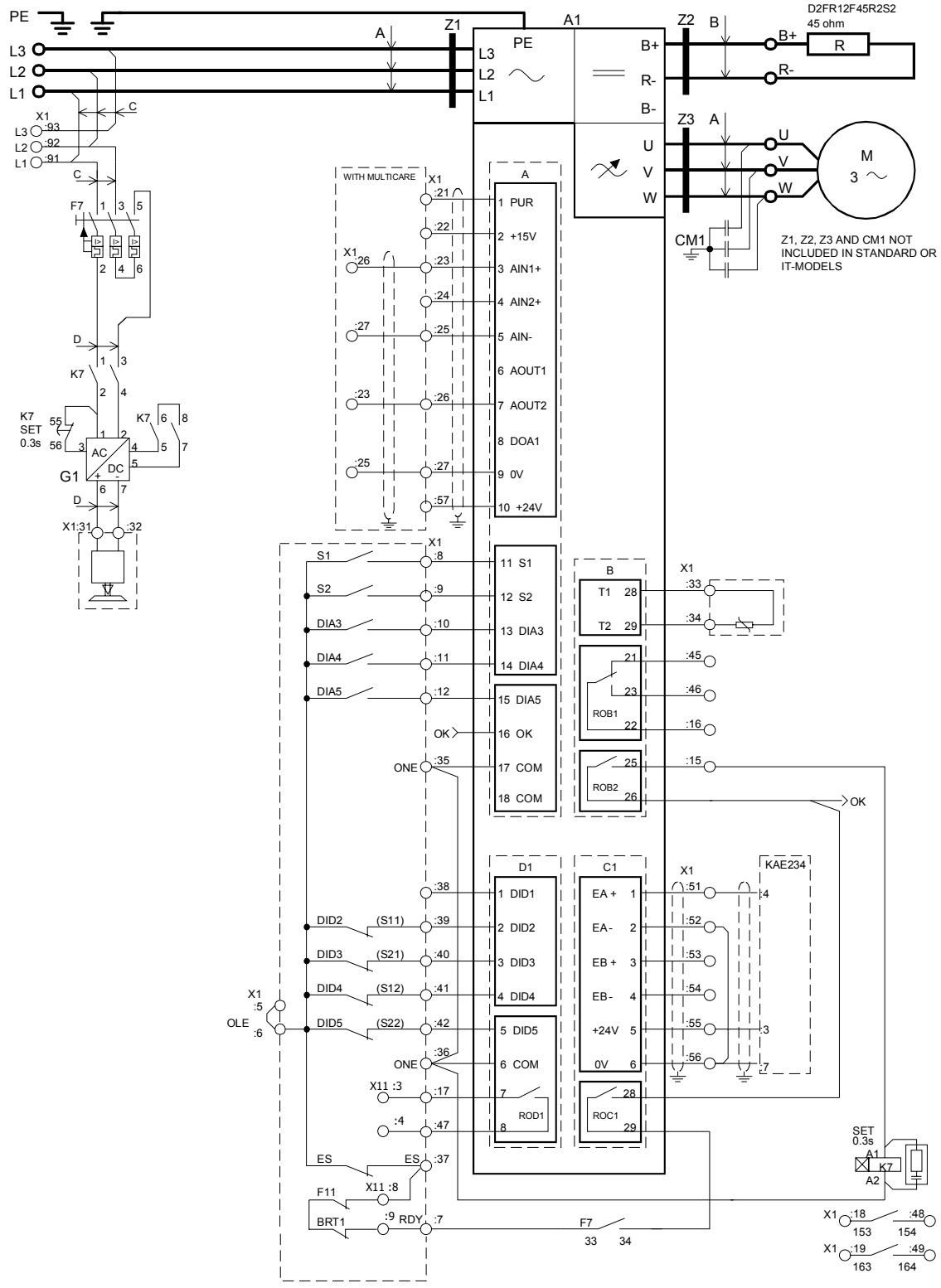
015F



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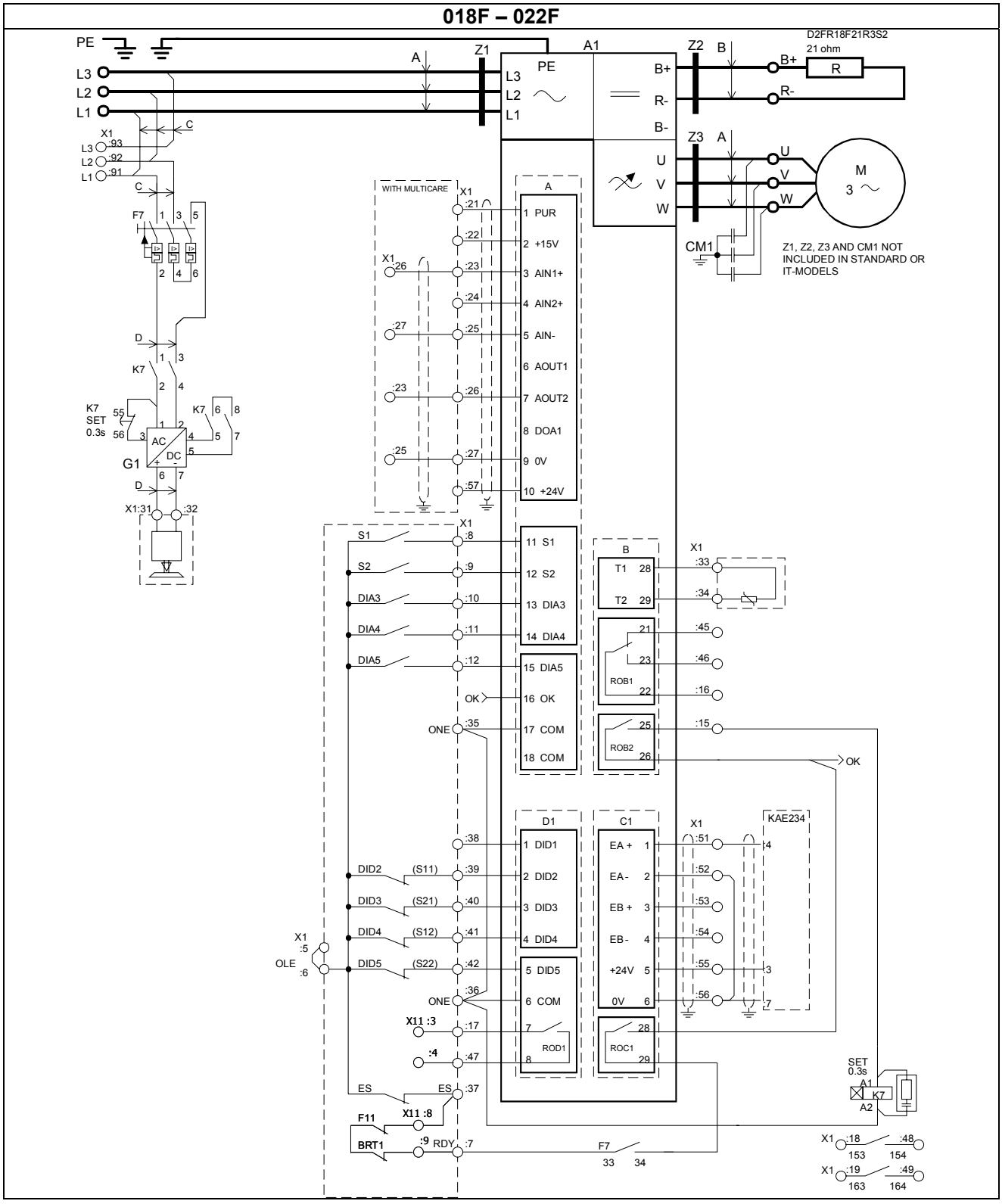
018F – 022F



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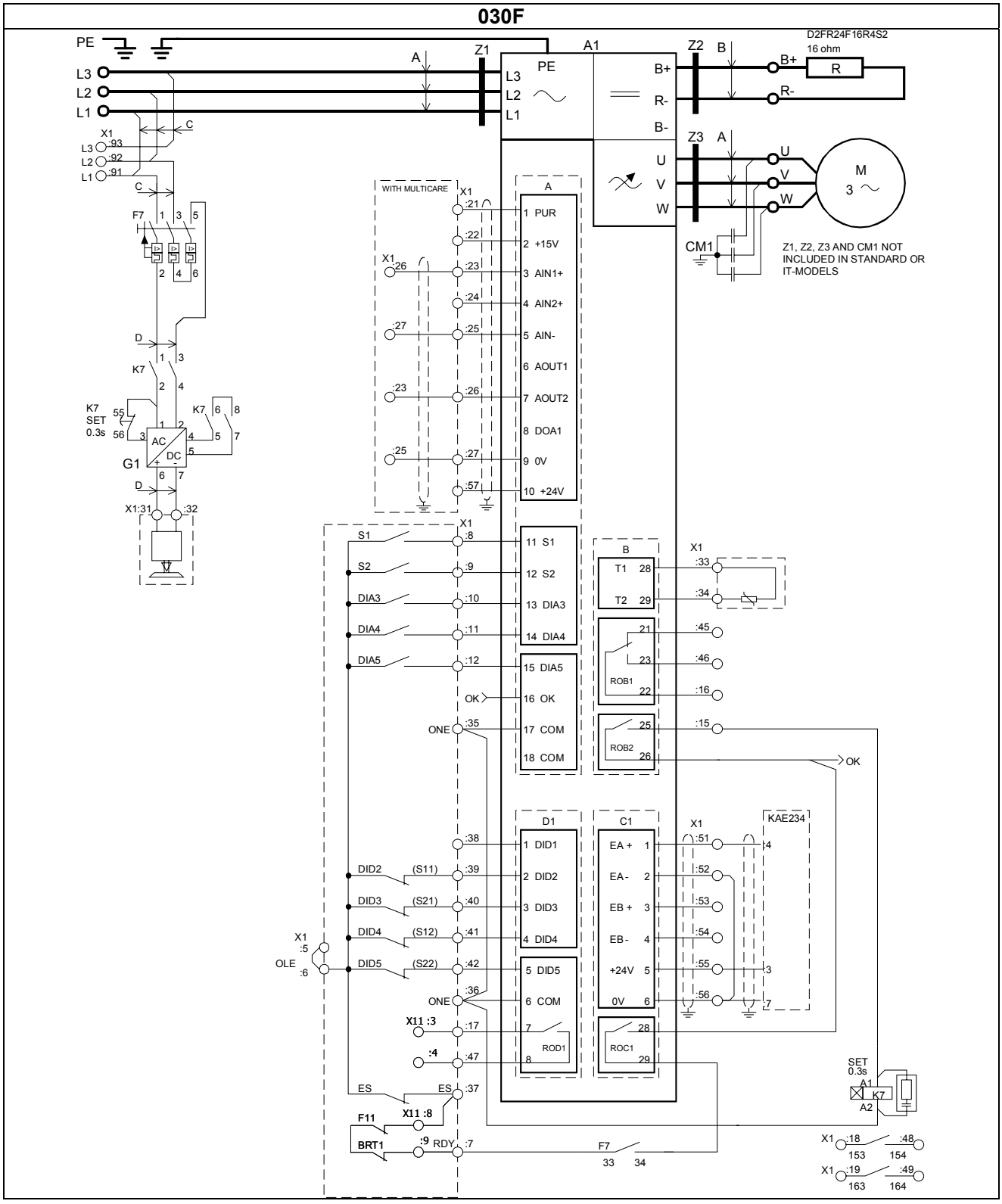
030F



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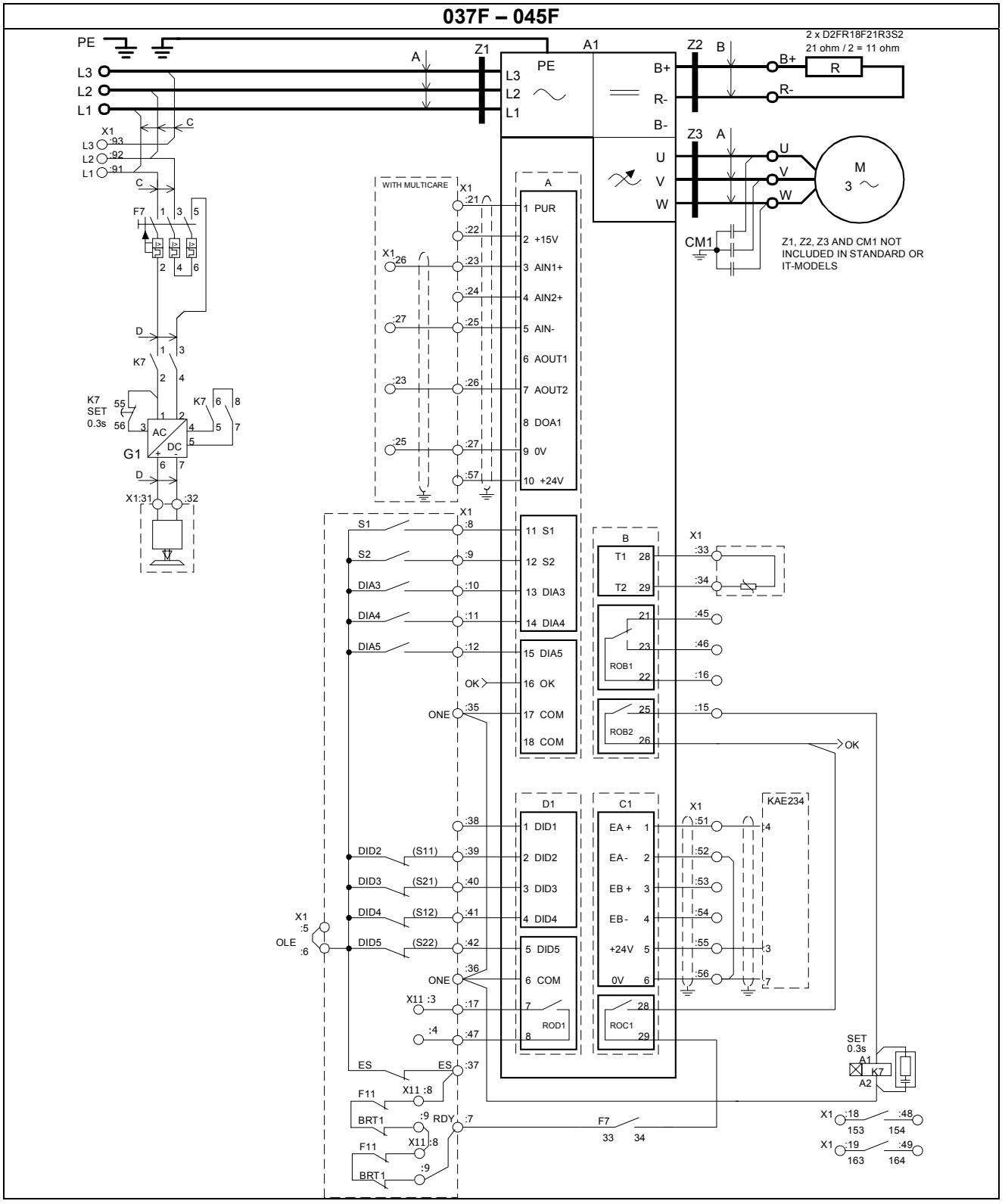
037F – 045F



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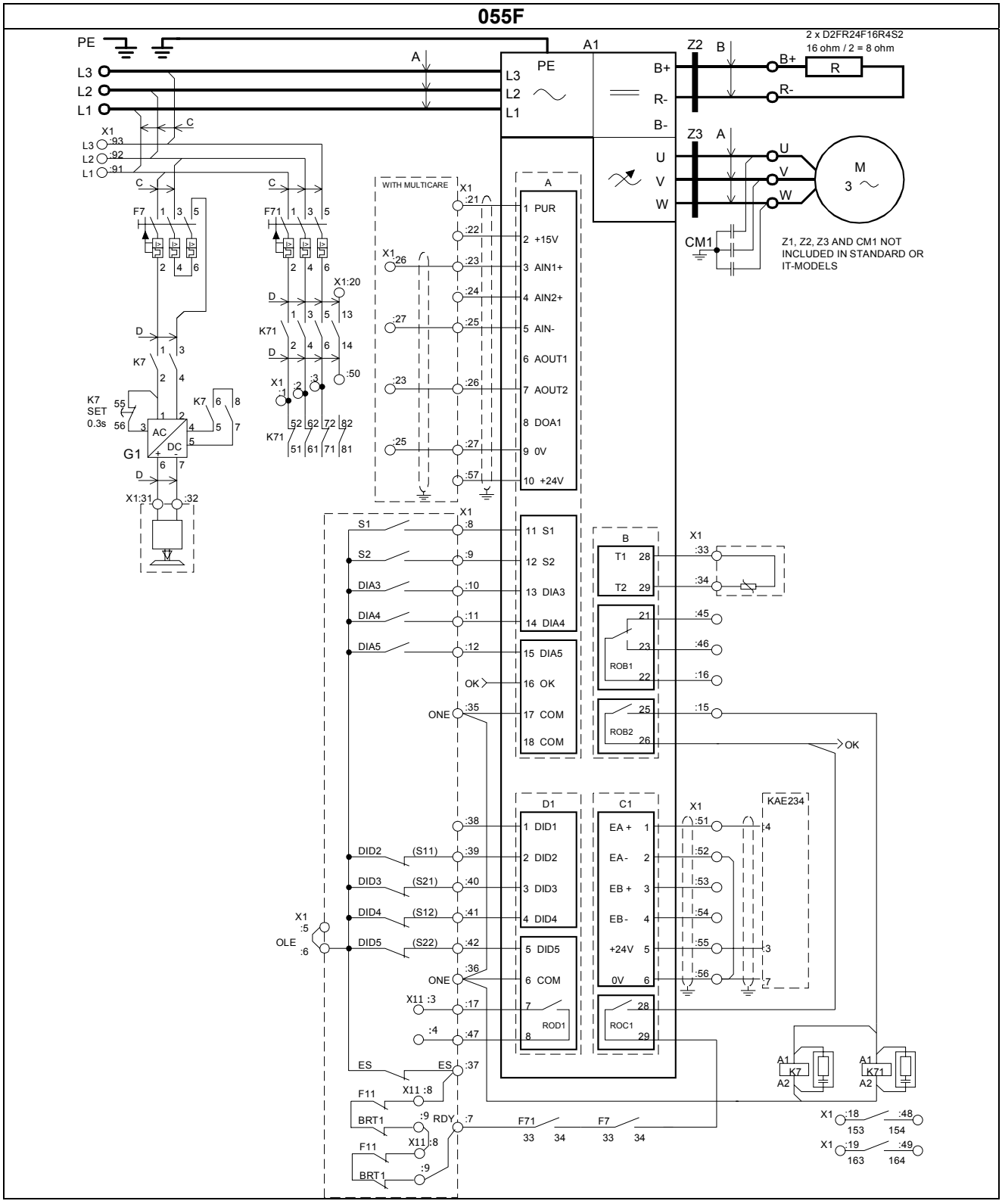
055F



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14.4 Circuit diagrams for braking resistors

- D2FR06FR0S2
- D2FR12FR2S2
- D2FR18FR3S2
- D2FR24FR4S2

14.4.1 Internal wirings

A	B	Other single wires
D2FR06FR0S2 2.5 mm² AWG 14	1.5 mm² AWG 6	0.75 mm² AWG 20
D2FR12FR2S2 6 mm² AWG 10		
D2FR18FR3S2 6 mm² AWG 10		
D2FR24FR4S2 10 mm² AWG 8		

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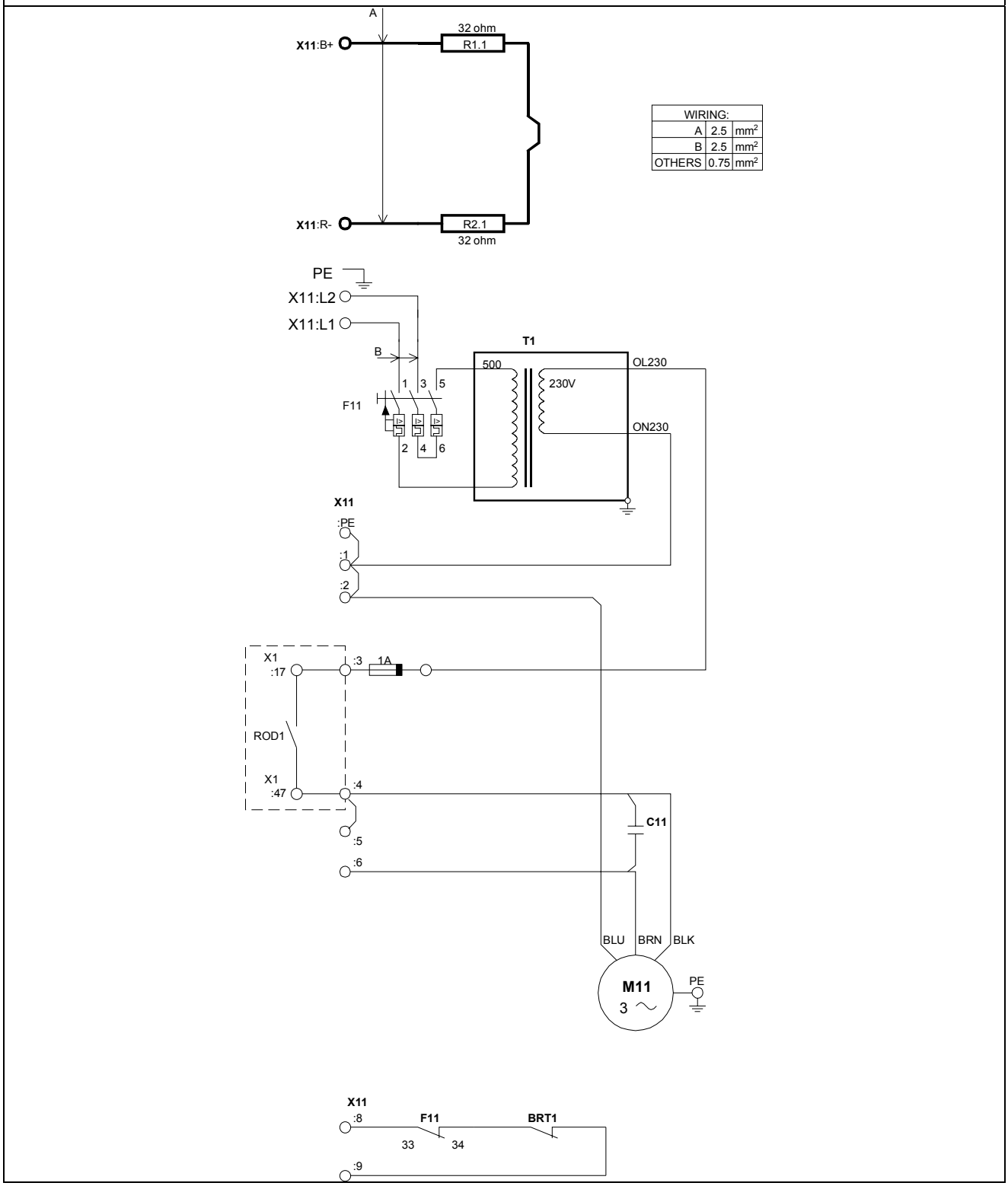
D2FR06FR0S2



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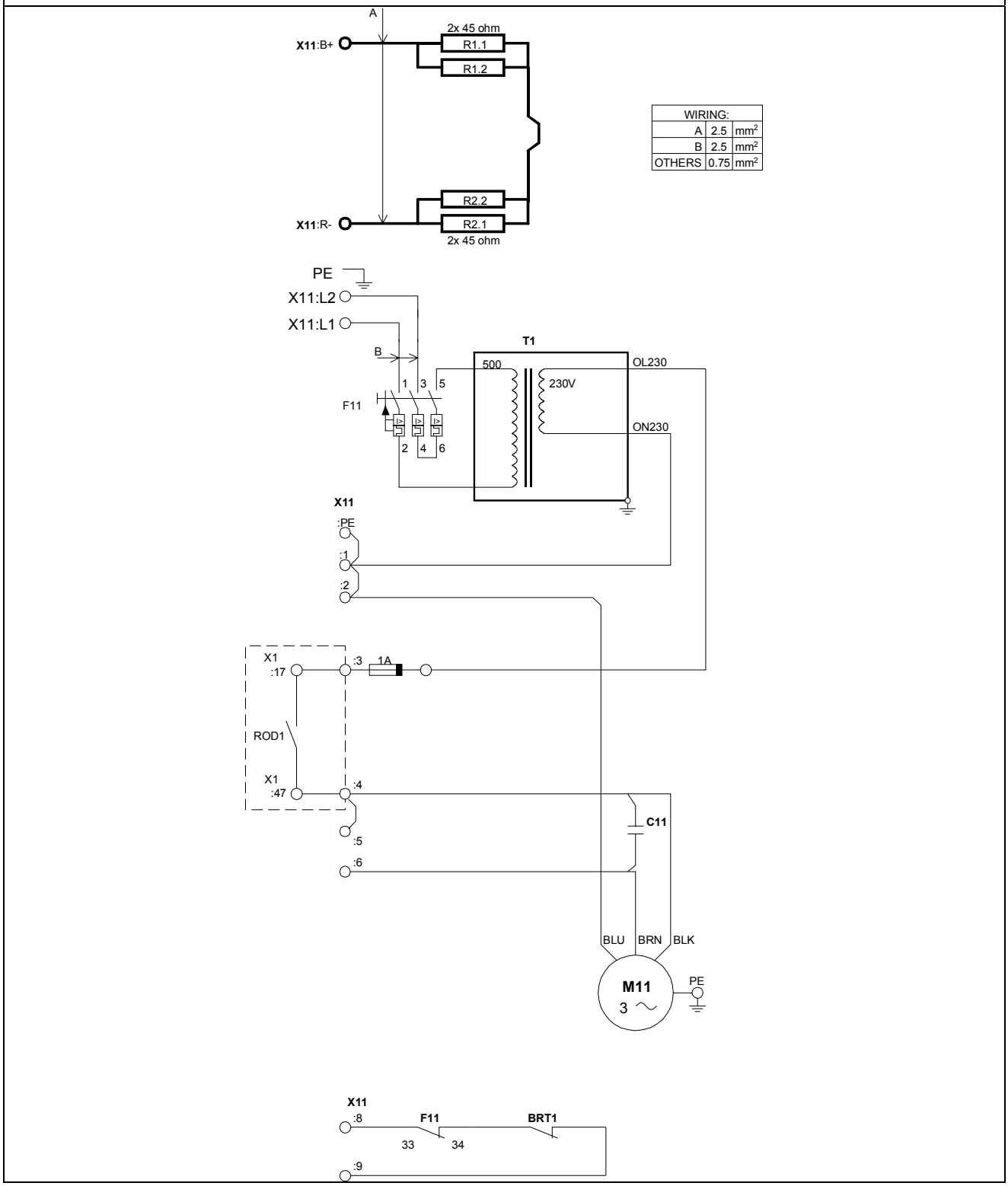
D2FR12FR2S2



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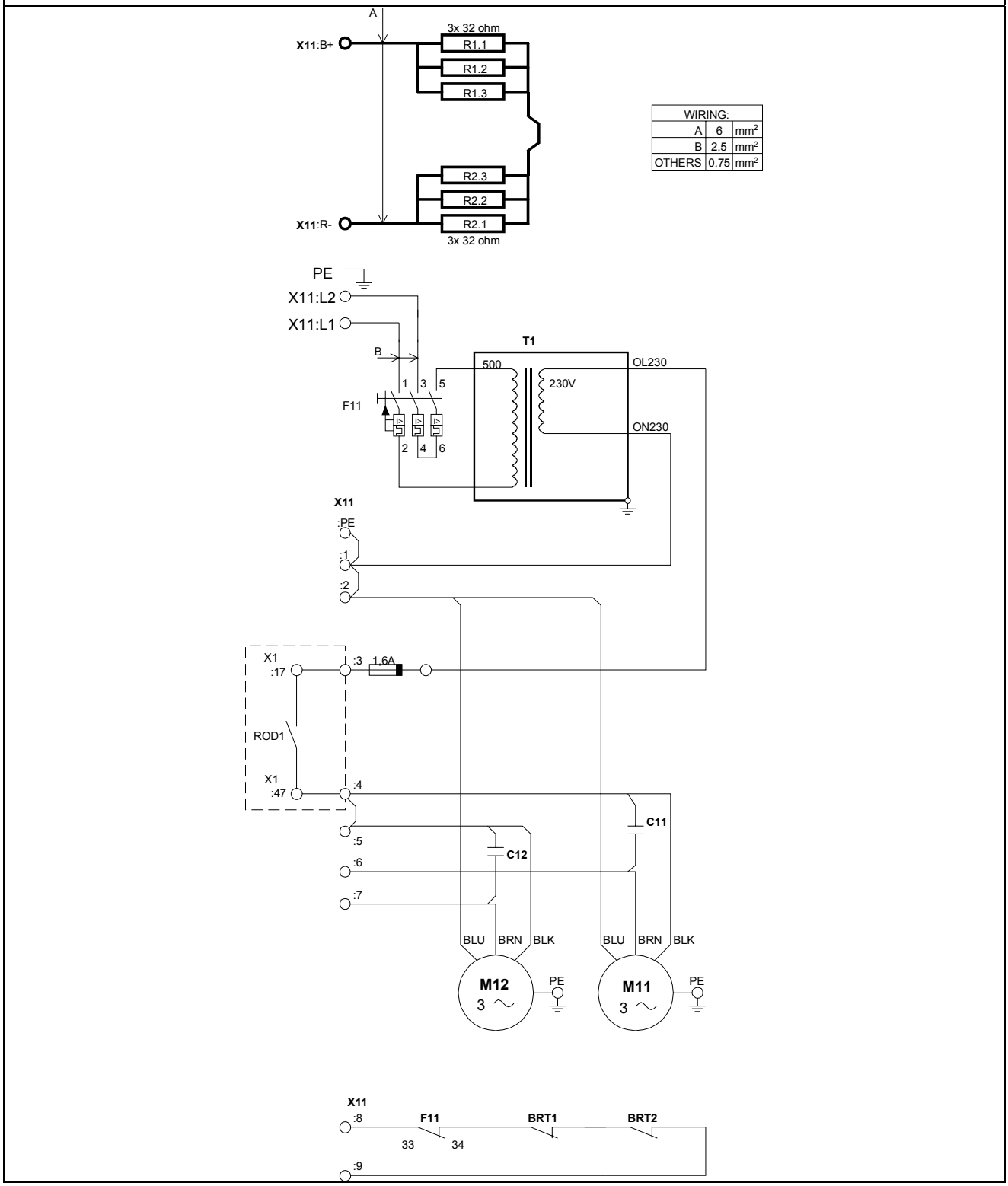
D2FR18FR3S2



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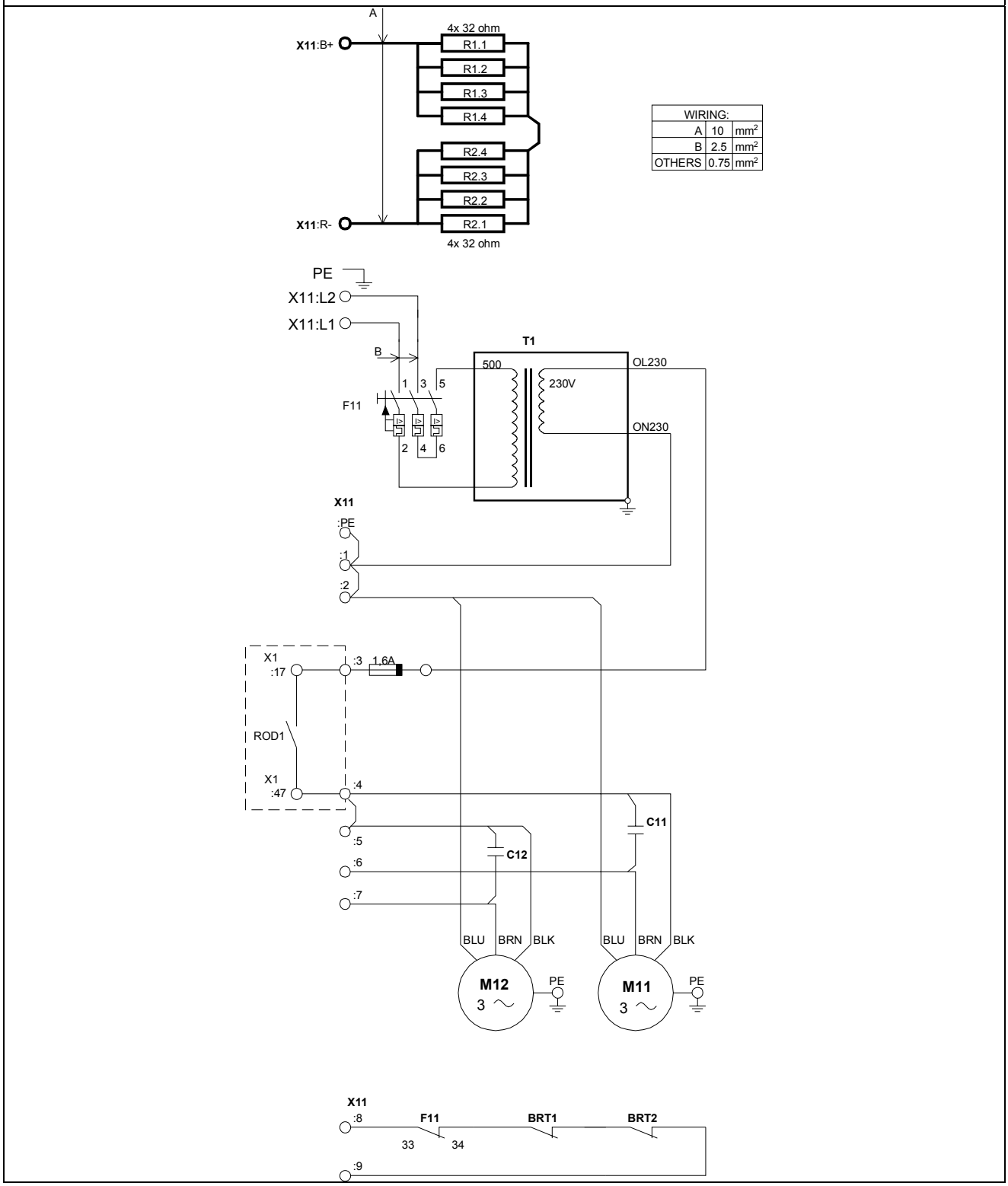
D2FR24FR4S2



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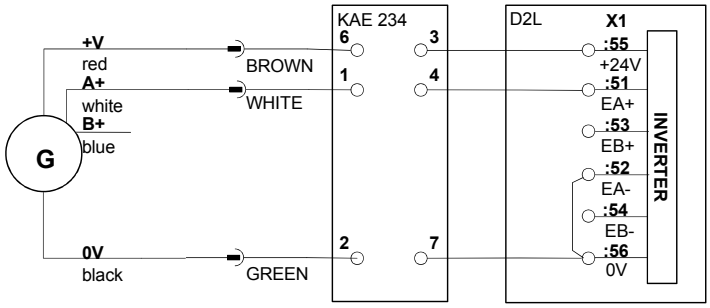
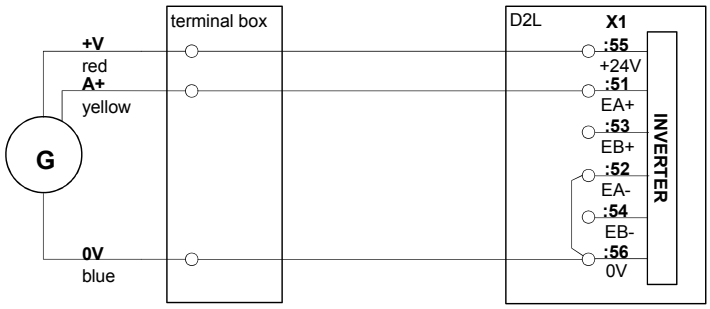
14.5 Standard connections for pulse sensors.

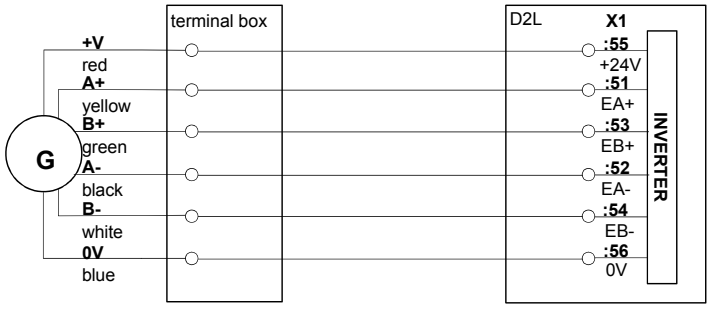
Standard connection with sensor bearing.



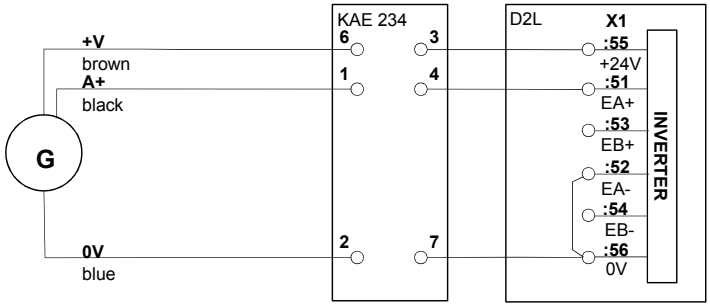
Standard connection with encoder 24 ppr.



Standard connection with encoder 600 ppr or more.



Standard connection with proximity switch. Baumer / Schönbuch.



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14DRAWINGS

14.1 Description of terminals

14.1.1 Power classes 002F - 011F

No	Name	Description, signal level
	PE	
L1	L1	Power supply, phase 1
L2	L2	Power supply, phase 2
L3	L3	Power supply, phase 3
B+	B+	Braking resistor
R-	R-	Braking resistor
U/T1	U/T1	Motor output, phase 1
V/T2	V/T2	Motor output, phase 2
W/T3	W/T3	Motor output, phase 3

No	Name	Description, signal level	No	Name	Description, signal level
1	BL1	AC brake supply, phase 1	31	BD1	DC brake supply 1
2	BL2	AC brake supply, phase 2	32	BD2	DC brake supply 2
3	BL3	AC brake supply, phase 3	33	T1	Thermistor input
4	T12	Reserved for thermistors connections	34	T2	Thermistor input
5	OLE	External control voltage, 42/48/115/230Vac	35	ONE	Neutral of external control voltage OLE
6	OLE	External control voltage, 42/48/115/230Vac	36	ONE	Neutral of external control voltage OLE
7	RDY	Stop with brake	37	ES	External Stop
8	S1	Direction 1 run command	38	DID1	Free input
9	S2	Direction 2 run command	39	DID2 (S11)	Slowdown signal, direction 1
10	DIA3	Accelerate / speed 2	40	DID3 (S21)	Slowdown signal, direction 2
11	DIA4	Not used / hold / speed 3	41	DID4 (S12)	Stop limit signal, direction 1
12	DIA5	Not used / speed 4	42	DID5 (S22)	Stop limit signal, direction 2
13			43		
14			44		
15	K7-A1	Coil of brake contactor K7	45	ROB1-21	Not used
16	ROB1-22	Not used	46	ROB1-23	Not used
17	ROD1-28	Free NO-contact of relay ROD1	47	ROD1-29	Free NO-contact of relay ROD1
18	K7-153	Free NO-contact of K7	48	K7-154	Free NO-contact of K7
19	K7-163	Free NO-contact of K7	49	K7-164	Free NO-contact of K1
20	K71-13	Free NO-contact of K71	50	K71-14	Free NO-contact of K71
		PE			

21	PUR	Not used	51	EA+	Encoder channel A+
22	+15V	Not used	52	EA-	Encoder channel A-
23	AIN1+	Multicare speed reference input, 0...+10V	53	EB+	Encoder channel B+
24	AIN2+	Not used	54	EB-	Encoder channel B-
25	AIN-	Common for analog inputs	55	+24V	+24V output for encoder
26	AOUT	Multicare speed reference output 0...+10V	56	0V	Common for encoder supply
27	0V	Common for analog output	57	+24V	External supply for Control module
		PE			

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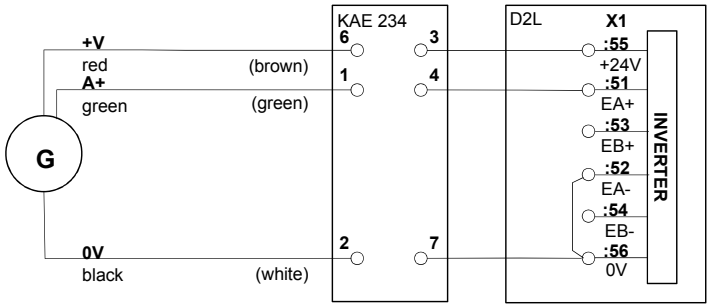
Standard connection with proximity switch. Honeywell. (Colour if cable has been lengthened)	

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